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ABSTRACT

This report is a collection of twenty papers which focus on the development of a rational and relevant philosophical premise upon which a national effort can be initiated and pursued to employ technology in services to the handicapped in general and the blind in particular. Special attention was directed to the identification and demonstration of applications of science and technology to the education, training, and employment of the blind. Recommendations are made for program and financial activities to be pursued by state agencies and consumer organizations of the blind in the implementation of a viable technology-based program of rehabilitation. This report is appropriate for introductory-level text for inservice training of rehabilitation staff in the philosophy and application of technology and telecommunications in services for the blind. (Author/DAG)

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TECHNOLOGY AND THE HANDICAPPED: TELECOMMUNICATION SERVICES
IN THE REHABILITATION OF THE BLIND

Edited by

Nathaniel N. Pullwood, Ph.D.

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Conference
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Wrightsville Beach, North Carolina

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I am tremendously appreciative to the many individuals who have been of vital assistance to me, first of all, in planning for the short-term rehabilitation training conference on "Technology and the Handicapped: Telecommunication Services in the Rehabilitation of the Blind," conducted on October 26-29, 1976, at Wrightsville Beach, North Carolina. I wish to acknowledge the perceptiveness of the Rehabilitation Service Administration in Atlanta, Georgia, in their review and approval of the proposal to fund a unique, ambitious, and, to say the least, what appeared to some to be an unrealistic project.

I am very grateful to the Raleigh Lions Clinic for the Blind for consenting to submit the proposal to the regional office and, subsequently, to be totally responsible for the fiscal administration of the short-term rehabilitation training grant. Mr. James Wells and his staff spent many hours processing forms and writing checks for individuals who attended the conference from the eight states of Region IV.

I wish to thank Dr. William B. Waters and his very fine staff at the Division of Services for the Blind of the North Carolina Department of Human Resources for providing diligent assistance in planning and conducting the conference as well as the preparation of this report. Specifically, I would like to acknowledge and express my sincere appreciation to Mr. L. Earl Jennings, Special Assistant to the Director of the Division of Services for the Blind, for coordinating the logistics for the conference and the preparation of this publication. I am also appreciative to Mr. W. Michael Haswell for serving as both the coordinator of logistics for the "Operational Applications of Technology" segments of the conference and as the official conference recorder. Also, I would like to express my gratitude to Mr. William Ballenger, Research Associate in the Office of Research and Extension Services of the School of Education at North Carolina State University.

Finally, I am greatly indebted to each of the contributors to the conference and this publication. Without the interest, commitment, expertise, and cooperation of each of the individuals and organizations, the conference would not have been possible. I am sure that the knowledge, skills, and philosophies of these participants will go a long way in building a viable technology-based program of services to the blind and physically handicapped.

Nathaniel M. Pullwood
Editor

PREFACE

The contents of this report are based solely on the proceedings of the conference on "Technology and the Handicapped: Telecommunication Services in the Rehabilitation of the Blind" held at Wrightsville Beach, North Carolina, on October 26-29, 1976. The contributors to this publication are individuals or organizations who presented papers and/or "Operational Applications of Technology" at the conference.

This publication is the result of a short-term rehabilitation training grant awarded to the Raleigh Lions Clinic for the Blind for the Division of Services for the Blind of the North Carolina Department of Human Resources. Responsibility for program planning and delivery of short-term rehabilitation training under the provisions of the grant, as well as the subsequent report, was charged to the Division of Services for the Blind at Raleigh, North Carolina.

The focus of the conference, and the subsequent publication, was upon the development of a rational and relevant philosophical premise upon which a national effort can be initiated and pursued to employ technology in services to the handicapped in general and the blind in particular. Further, special attention was directed to the identification and demonstration of applications of science and technology to the education, training and employment of the blind. Finally, the combined forces of advocates, technologists and rehabilitation specialists have culminated in specific recommendations for program and financial activities to be pursued by state agencies and consumer organizations of the blind in the implementation of a viable technology-based program of rehabilitation.

This publication is appropriate for an introductory-level text for inservice training of rehabilitation staff in the philosophy and application of technology and telecommunications in services for the blind. It places before the reader the issues, problems and potentialities of science and technology in the rehabilitation service delivery system. It forces the reader to look beyond the traditional approaches to serving the blind to the consideration of technology as a coalescent or companion service. It is generative of new thinking with regard to the role of science and technology in the social and behavioral sciences in the provision of human resource services to the disabled in order to make these people self-sufficient and self-supporting citizens of this society.

This report is not to be construed as a scholarly work of research, but rather as a practitioner's concept of a new and emerging redefinition of the traditional service delivery system for the blind and physically handicapped.

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INTRODUCTION

Nathaniel N. Pullwood

Elizabeth City State University
Elizabeth City, North Carolina

The tradition in the rehabilitation of the blind has been reflective of benign neglect and for the most part has been treated as a stepchild. The specificity and uniqueness of its goals and service objectives have escaped the rigors of definitiveness in terms of both administration and the service delivery process. The results have been superficial, and, to a great extent, the effects on blind clients with respect to self-support based upon their maximum rehabilitation potential have been supercilious, to say the least.

Unquestionably, the lack of administrative and program integrity has culminated in serious gaps in the outcomes of service delivery as well as the programs to train rehabilitation staff in the "work for the blind" process. Essentially, individuals who are blind, because of the nature of their rehabilitation programs, are placed into jobs which are menial and traditional in nature and below their rehabilitation potential.

The emerging recognition that viable alternatives to traditional rehabilitation services exist within our greater society has brought us to the threshold of relevancy in the rehabilitation realities of the blind. Counseling and guidance, diagnostic evaluation, income maintenance, traditional training, and traditional physical restoration services will not and cannot, as stand-alone services, render a blind individual or any person employable or independent. Consequently, immediate action is essential in order to initiate a training of rehabilitation staff to deliver a more meaningful and practical service for rehabilitation.

The goal, then, of this publication is to initiate the first step in the long and complex process. This report has a two-fold purpose: first, it is a written report of the events and contents of the conference on Technology and the Handicapped: Telecommunication Services in the Rehabilitation of the Blind held at Wrightsville Beach, North Carolina, on October 26-29, 1976. Second, it supports the establishment of a framework on which training and retraining of rehabilitation staff can take place to implement the process to genuinely rehabilitate, in a self-supporting and independent manner, the blind and physically handicapped. The congressional mandate to serve first the most severely handicapped requires a reappraisal and reassessment of current services to determine whether the capability or the capacity exists in the present service delivery system.

Thus, the primary objective of this publication is to set forth a concept of technology-based rehabilitation as a viable philosophy and principle, as a practitioner's tool, as an administrative and management technique, and as a consumer's reality in his program of rehabilitation. The needs and exigencies of the blind and the physically handicapped with respect to independence in the community and the job demands on rehabilitation managers--the requirement to train service delivery personnel in the philosophies, economics, applications, and utilization of technology and telecommunications in the rehabilitation service delivery system of the blind and the physically handicapped--must be considered. This publication presents, then, the concept of technology-based rehabilitation services including (1) the problem of philosophies, (2) the historical emergence of technology in the social and behavioral sciences, (3) the economic issues, (4) the design and utilization problem, (5) the role of the consumer, and (6) some actual technology applications to education, training, and job placement of the blind and visually impaired.

This document constitutes the groundwork for a future of strong advocacy and application of technology and telecommunication services. It represents a strong and burning desire and commitment by many, both consumers and providers, to bring into fruition programs, services, activities, and opportunities for the appropriate and proper use of machines in the human endeavor to be independent and individual. Too, it is a challenge to the Congress, the Rehabilitation Service Administration, and the state rehabilitation agencies to rethink and reprioritize the resources and opportunities of the rehabilitation program so that a reality of rehabilitation can replace, once and for all, the rhetoric of rehabilitation.

TECHNOLOGY AND THE HANDICAPPED:
THE LEGISLATIVE MANDATE

Thomas L. Birch

Legislative Assistant, Subcommittee on Select Education
Committee on Education and Labor
U. S. House of Representatives

The Rehabilitation Act of 1973, which is the basic legislation authorizing federal support for vocational rehabilitation programs benefitting handicapped individuals, has a number of basic goals. It seeks to encourage the development and implementation of rehabilitation services for all handicapped persons. It is designed to encourage rehabilitation agencies to serve disabled persons who might not have vocational goals in the traditional sense, but who would nevertheless benefit from appropriate rehabilitation services. It guarantees equal rights for handicapped persons in federal programs. And, finally, the Act seeks to encourage and to provide a means for coordinating technical and scientific research to meet the needs of disabled persons in a wide range of matters, from medical research to engineering and design studies of architectural and transportation barriers.

I would like to concentrate on those sections in the legislation which authorize federal support for research programs related to the rehabilitation of handicapped individuals. The law begins with a declaration of purpose which includes specific language mandating research activities. Section 2 of the Act reads, in part:

The purpose of this Act is to provide a statutory basis for the Rehabilitation Services Administration, and to authorize programs to -- . . .

(5) develop new and innovative methods of applying the most advanced medical technology, scientific achievement, and psychological and social knowledge to solve rehabilitation problems and develop new and innovative methods of providing rehabilitation services to handicapped individuals through research, special projects, and demonstrations.

Title II of the Rehabilitation Act provides the specific authorizations of federal assistance for research projects which bear directly on various methods and devices to assist in the vocational rehabilitation of handicapped individuals. Projects which may receive support under Title II include medical, scientific, and technical investigations into the nature of disabilities and restorative techniques; studies of industrial, vocational, social, psychological and economic factors affecting the rehabilitation of disabled persons; special problems of home-bound and institutionalized individuals; and studies in the

architectural and engineering design needed to meet the special needs of handicapped people.

The Act also authorizes grants for the specialized research activities of Rehabilitation Research and Training Centers, Rehabilitation Engineering Research Centers, programs for spinal cord injury research, programs for research in kidney disease, and a program for international rehabilitation research and training.

The sections just cited from the Rehabilitation Act of 1973 represent an affirmation by Congress of the importance of federal support for research in these areas. The 1973 legislation represents an expansion of the 1954 amendments to the Vocational Rehabilitation Act which provided authorizations for research, demonstration and training activities to advance state rehabilitation programs and voluntary programs. By promoting research and development in new technologies which can benefit handicapped people, Congress hopes to focus the attention of the scientific and engineering community on the special problems of handicapped individuals.

This intention was underscored with the passage of the 1973 bill. The Committee on Education and Labor, in its report accompanying that legislation, stated that it supports research aimed at the specific and unique problems encountered in delivering services to special groups of handicapped persons, and it recognizes that research, demonstration and training are vital components in the entire effort of vocational rehabilitation. In the 1976 fiscal year, \$24 million was appropriated by Congress for research and demonstration activities. In the new fiscal year, \$29 million is obligated for research projects.

The Rehabilitation Services Administration (RSA) is now funding a series of "state of the art" workshops to examine a number of areas for the purpose of accumulating documents and defining priority areas which should be further researched. Some of these workshops have already been held, and others are planned for the near future. All the recommendations will be brought together in a final workshop to be held early next year.

In addition to the research and training title of the Rehabilitation Act of 1973, the legislation directs RSA to confer with the National Science Foundation and the National Academy of Sciences in developing methods of applying medical and other technology to solve rehabilitation problems. As the major source of financing for research and demonstration projects to enhance the employability of handicapped individuals, including the blind, RSA has funded activities which improve rehabilitation techniques as well as develop devices. Although the focus of these efforts is on the enhancement of employment opportunities of individuals with handicapping conditions, many of the improved techniques and devices frequently have application for handicapped children and adults not in the age range of working people.

The RSA also supports two rehabilitation engineering centers which concern themselves with research, development and evaluation of devices for the blind and visually handicapped. These are the Smith Kettlewell Institute of Vision Services at the University of the Pacific in San Francisco and a center jointly operated by Harvard and the Massachusetts Institute of Technology.

The Rehabilitation Engineering Center at the Smith Kettlewell Institute has been engaged in developing pattern recognition and other sensory devices for the blind. The center at Harvard-MIT has been doing complementary work in this field by researching and evaluating techniques for the generation of sensory feedback to the human nervous system. This basic research will permit improvements and modifications in the pattern recognition devices being produced at Smith Kettlewell and, of course, by researchers at other institutions as well.

As I am sure you know, the Rehabilitation Act of 1973, as amended, contains specific language designed to preserve the integrity of the rehabilitation program in RSA, designating the agency as the principal authority for carrying out the purposes of the Act. This charge includes, of course, all grants management functions--except those which are routinely administrative and better centralized--that relate to projects in research, demonstration and training. It is obvious that final approval of grants in this area should rest under the Commissioner of the Rehabilitation Services Administration. RSA can better provide the leadership to delineate the priority areas of research. In addition, RSA is better suited to seeing that the research undertaken meets the objectives of the Rehabilitation Act. Also, there is a danger that, when research funds provided under the rehabilitation program are co-mingled with those authorized under other legislation, the activities and goals mandated by the Rehabilitation Act may not be met.

Many research activities are conducted by other agencies of the federal government, and I would like to touch on some of those which benefit blind and vision-impaired persons. For example, a major source of financing for research into the causes and prevention of blindness and vision disorders is the National Eye Institute, created by Congress through the Public Health Service Act. Also, the Veterans Administration has a medical research component which includes prosthetic research. Over the years, this research by the VA has helped to finance the development of various mobility and reading devices for the blind. The Bureau of Education for the Handicapped in the Office of Education finances research and development projects to improve the education of handicapped children, including the blind and visually handicapped. Under authority of the Education of the Handicapped Act, this agency has funded projects designed to improve educational methods as well as to develop special aids and devices to meet the educational needs of all types of handicapped children. Devices developed as a result of this activity frequently are useful for handicapped adults as well.

I might add here that the new Education for All Handicapped Children Act, developed by the Subcommittee on Select Education and of which Congressman Brademas was the chief sponsor, was signed into law in November of last year. This new measure authorizes special grants to state and local boards of education to pay the cost of altering existing school buildings and equipment to make them useful to handicapped students. The new act also authorizes grants to establish centers on educational media and materials for handicapped persons which will promote the use of new educational technology in education programs for the handicapped.

Another agency involved in research and development activity is the Division for the Blind and Physically Handicapped of the Library of Congress, which administers the program for producing and lending books in braille and recorded form for the use of blind persons and physically handicapped individuals who cannot handle regular printed material. As the principal source of library books and magazines in usable form for the blind, the Division's research and development effort has been focused primarily on improvement of recordings and playback equipment to meet the special needs of its clientele.

OPERATIONAL APPLICATIONS OF TECHNOLOGY

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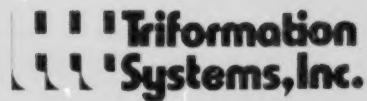
The above list is in no way exhaustive. With the now availability of the micro-computer, our imaginations at Triformation Systems, Inc. are active in a determined effort to bring many more employment and educational opportunities to the blind and visually impaired. We cordially invite all who read this page to visit, call or write to us.

Lee Brown

Lee Brown
Director of Marketing Services

LB/sc
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POLICY AND SOCIO-ECONOMIC IMPLICATIONS

Vincent Sardella

Office of Telecommunications Policy
Executive Office of the President

I think my remarks will be in the vein your program planners had in mind, but I cannot claim the title printed on your agenda, with its ambitious reference to "Technology Assessment." I don't know what "technology assessment" is. The most prominent institution seemingly engaged in that activity, the Congress' Office of Technology Assessment, completed some fine work in their initial year, some of it in the field of telecommunications. But a definition of the term "technology assessment" was not among their accomplishments. To parallel the famous definition of physical chemistry by the founder of that discipline, technology assessment must be "whatever interests them."

The common thread among those who do hazard definitions is the prediction and evaluation of the secondary, long-term societal effects of technical innovations. But most good planners have always attempted to take such effects into account, and where primary effects stop and secondary effects begin is subjective. Nevertheless, such studies no longer stop at estimates of new jobs created, the time saved in travel, or growth of the gross national product. Most take into account effects on the quality of life of people far removed from the center of technical innovation, not only by distance and occupation but by generations.

I am going to discuss some of the developments in telecommunications we perceive at the Office of Telecommunications Policy that may have a significant impact on the development of services for the handicapped, in both the near and distant future. The word "may" is emphasized because the specialists in your field are best qualified to judge the significance of these developments. At the federal level, those specialists are principally at the Department of Health, Education, and Welfare. With one or two notable exceptions, the policy issues deliberated at the Office of Telecommunications Policy (OTP) are not at a level of resolution that permits detailed evaluation of social service effects. Before continuing on the main track, let me describe, very briefly, the Office of Telecommunications Policy.

OTP's primary role is to examine significant issues in telecommunications and to develop and present policy positions for the executive branch. The director of the office is the president's principal advisor on telecommunications. In developing a policy position, OTP seeks to obtain views from interested organizations and also commissions and performs research to supply needed information and analysis relevant to

the issues involved. Our policy positions may be disseminated in the form of circulars within the executive branch, submissions to the Federal Communications Commission, or, occasionally, draft legislation for presidential submission to Congress. OTP has three functional divisions: Frequency Management, Government Communications, and International Communications. The General Counsel's Office and the Office of Planning and Policy complete the organizational structure.

The Office of Planning and Policy is responsible for planning the use of OTP's resources on the analysis, evaluation and development of recommendations concerning national telecommunications policy issues. The Office is the focal point of OTP's activities on domestic telecommunications policy initiatives. To accomplish its objectives, Planning and Policy includes sections concerned with common carrier studies, with industry and private sector contacts, and with the conduct of research for OTP.

What are the policy issues that OTP has been and is analyzing, and how are they related to social service applications? In the common carrier field, they are the issues of growing competition in markets that were traditionally monopoly markets, such as customized terminal equipment and private lines for specialized services. In the mass communications field, they are the issues of introducing the benefits of technological innovations, such as the broadband capability of cable television, without jeopardizing traditional and highly valued broadcast services to those who will not have the immediate benefits of innovations. In the field of information policy, there are the issues of protecting individual rights of privacy in an environment where massive data banks on our personal, financial and job-related activities can be accessed by and transferred among computers and used by both government and commercial institutions, often without individual knowledge or control.

But there are also narrower issues more directly relevant to your interests, such as the use of part of the normal television broadcast channel, currently unused, to transmit special information to homes equipped with special decoders for its reception. The most immediately realizable service for this unused signalling capacity is a system of closed captioning for the deaf. OTP has been active in encouraging this new service, and last Friday President Ford issued an announcement that noted the desirability of captioning and requested the director of OTP to work with industry in developing a plan for realization of a closed captioning system.

Other uses of this valuable resource need not be directly related to the program. At least one researcher in the field, the Atlantic Research Corporation, suggested the transmission of data receivable on a braille typewriter terminal.

Another narrowly defined issue is the design of regional and national disaster warning systems with special features for the handicapped, a concern of OTP's Government Communications office. This office was also instrumental in promoting adoption of the nine-one-one (911) emergency calling system, a convenience for every citizen but perhaps much more beneficial to some of the handicapped.

These broad policy issues arise and are given urgency by technological developments whose significance for social service applications is evident. The technological developments are those that permit an explosive growth of telecommunications capacity for both commercial and individual uses. Those uses will eventually justify the capital investments for such growth of total telecommunications capacity and permit the social service applications--in particular, services to the handicapped--to be provided on the basis of shared costs and perhaps marginal costs.

The technological development you are probably most familiar with, and indeed the one involved as a component in so many of the current NSF and DHEW experimental projects, is the coaxial cable system, or so-called broadband system. Now, I don't intend to resurrect the fanciful daydream, so tiresomely recounted over the past several years, of how the proliferation of cable systems to satisfy the average citizen's voracious appetite for television would soon provide the basic framework for provision of every health, educational and social service imaginable. But there is a modified version of that daydream that is worth mentioning, because the modifications make sense. The modified version no longer depends on coaxial cable technology, or the cable television industry, or television demand as the driving force, although all of these remain as components. The most significant new ingredient in the modified version is the telephone company, exploiting the new technology of fiber optics. Fiber optics employs light waves traveling through glass fibers to transmit messages. A one-half-inch-thick cable encasing glass fibers can carry the equivalent of 100 video channels with currently developed associated electronic equipment. This capacity is sufficiently great that, potentially, a single network could carry all of the telephone or so-called "narrowband" services as well as all the audio and video broadcast channels, the so-called "broadband" services.

However, while the telephone company may be the provider of this high-capacity transmission plant, it need not be the sole provider of services on it. A competitive information service industry that would lease capacity on this network from the telephone company is possible, and from a policy point of view, one of the many such arrangements may be desirable. Indeed, service providers (whether banks, stores, educational or entertainment programmers, or local and state governments providing social services) may operate under a sub-lease arrangement. They would sub-lease individual channels from a so-called broadband systems operator who leases, on a wholesale

basis, a large number of channels from the telephone company and who also provides the centralized, computer-controlled system that would permit individual service providers to deal with their designated subscribers. Such an arrangement can have many advantages including the consumer benefits that result from competition.

Finally, this modified futuristic concept does not depend on television demand for its motivation, a questionable force in the large cities that traditionally nurture such innovations. Rather, it is likely to emerge from the constantly growing commercial data services, the development of electronic funds transfer services, and the anticipated electronic mail services that will first serve business establishments but may eventually include every residence.

The growing telephone capacity needed for business data communications is a recognized fact. Electronic funds transfer, even at the residential level, has been implemented on a small scale. In Seattle, residents can pay their utility and other bills by entering code numbers on their touchtone telephones, following recorded verbal instructions from a computer, and the burgeoning use of fax machines using telephone couplers is the forerunner of electronic mail services.

These are significant complements to the demand for broadcast-type entertainment services. Coupled with the rapidly developing potential of fiber optics technology, this modified concept of the future of telecommunications seems, for the time being at least, somewhat more credible than the concept that uses cable television as a base.

Historically, the significance of major telecommunications developments for the handicapped has been that it permitted many of them to utilize, on virtually equal terms, the best available technology for some forms of interaction, education and entertainment. In these terms, it is difficult to cite any development in the recent past, or anticipate one in the near future, that rivals the introduction of basic telephone and broadcast services, 100 years and 50 years ago, respectively. Despite their overwhelming impact on the social, commercial and personal lifestyles of most Americans, they were, in fact, substitutes for other forms of communication. But for many of the handicapped, they were not merely a substitute for, but an introduction to, some forms of communication.

This very same observation holds for some recent and anticipated developments in telecommunications. Many of you are more familiar than I am with projects, both experimental and operational, that exploit telecommunications and computer technology to permit the handicapped to work, for the first time, as typists, computer programmers and bank clerks. Eventually, when shopping, paying bills, and adult education courses via communications to and from the home become conveniences and good substitutes for most Americans, many of the handicapped will

engage in those activities for the first time, using the best technology available for anyone.

Even the modifications to standard input and output devices needed to accommodate a wider class of handicapped may be simpler and less costly to achieve in the future. This is because an increasing number of firms can be expected to enter the terminal equipment market by virtue of a liberalized policy for the interconnection of terminal equipment to the telephone network. We can expect even government-subsidized equipment development programs to benefit from an expanded source of ideas, technological specialties and price competition. In addition, the increasing forms of communications requiring digital data as inputs and outputs (which you can think of as the dots and dashes of Morse code) rather than the analog data (for example, the direct conversion of voice sound waves to electrical waves) may simplify the problems of designing terminal equipment for the handicapped. This is because originating or receiving digital data signals at the terminal, using a variety of mechanical devices or sensory stimuli, is easier than performing the same task when the signals are, for example, of the type generated by sound waves.

As a final point, it is useful to note that some of the problems of providing telecommunications services for the handicapped are particular cases of the more general problems of serving minority audiences in our mass communications systems. To serve a proportionately small audience economically, you must be able to aggregate it on a regional or national basis. Advances in computer, satellite and transmission technology are all in the direction of facilitating this aggregation.

The "telebook" service, an experiment funded by the Library of Congress and conducted by the Mitre Corporation in the Washington, D. C., area, may illustrate this point. The Mitre project tested the concept of transmitting records of books to the blind from a central location, a service which, in fully operational form, would overcome the limited selection and long delays of a mail delivery system. In its test version of this service, Mitre used standard telephone lines and could serve only ten requests simultaneously in the Greater Washington area. But in an operational service, one would use about a hundred audio channels in a broadband system, obtaining substantially better sound quality and service availability than in the Mitre test environment.

The broadband capacity of the modern metropolitan cable system makes the reservation of a hundred audio channels a practical and economical reality, even if subsidized by public funds. However, not every community could be expected to maintain a sizable collection of recorded books. One can conceive of regional, computer-stored libraries that would serve all the community systems in a state, or perhaps in several states. Simultaneous transmission from this central library to individual community systems and their individual subscribers

would not be economically practical, but if requests were to be placed 24 hours in advance, it would be possible to use rapid transmission of the requested book from the central library to a recording device at the community system head end during off-peak hours--late at night, for example. The subscriber could then receive the recording on an audio channel of the cable system on the following day. The rapid transmission from the central library to the metropolitan system might employ satellite, microwave or standard land line transmission. In this manner a single central library might serve a region or several states or conceivably the entire nation, aggregating the small proportion of the public that would use this service with only a short delay between the request and receipt of service.

It is noteworthy that the Department of Health, Education, and Welfare has its own Office of Telecommunications Policy, and so can be expected to remain active in pursuing opportunities in telecommunications that lead to improved social services. OTP staff members at present have contact with that office and with other offices in the executive branch that have telecommunications programs. However, at OTP we are considering the establishment of more formal, permanent, interagency reporting and information exchange systems for telecommunications projects. That may not only improve our awareness of the secondary effects basic policies may have on special population segments, but it may enable the individual agencies to plan their own programs better in anticipation of specific telecommunications industry trends.

OPERATIONAL APPLICATIONS OF TECHNOLOGY

Kentucky Division of Special and Technical Services

OPERATIONAL APPLICATIONS OF TECHNOLOGY IN KENTUCKY

T. V. Cranmer

Division of Special and Technical Services
Bureau for the Blind

The Rehabilitation Act of 1973 makes it mandatory for state rehabilitation agencies to enlarge their services to handicapped individuals through the provision of sensory and telecommunication devices. This represents an extremely high level of recognition of the importance of technology to the rehabilitation process. We in Kentucky are particularly pleased by the appearance of this language in the law since it encourages us to pursue with greater energy some programs which we had initiated a few years ago. The federal Act paved the way for including in our own state statutes the requirement that our Bureau for the Blind have a Division of Special and Technical Services.

The Division has five important functions, the first two of which are continuations of long-time practices familiar to everyone in the field of work for the blind:

(1) The Division presently operates two recording centers. One is housed in a library in the western part of our state (Owensboro-Daviess County) and the other in the Student Center at the University of Kentucky. These recording programs utilize the manpower of volunteer readers who produce college texts and other materials for the blind students enrolled in our colleges and universities. The books are recorded and duplicated at these two locations while the master copy is sent to our central office at Frankfort, where it is retained for a number of years to meet the future needs of blind Kentuckians. We also make available copies of our recordings to students elsewhere in the country, although we do not originate masters for residents of other states.

(2) The Division stockpiles and distributes to clients in the state technical aids and appliances which have been obtained from sources in the United States and several other countries. These aids and appliances are selected on the basis of their usefulness in terms of education and employment of the blind. At this time our catalog is distributed only to counselors in Kentucky. Our counselors select from the catalog items needed by their clients and order them directly from the Special and Technical Division without cost to their case service allotments. This point should be of considerable interest to rehabilitation counselors everywhere since it enables them to provide all of the sensory aids needed by their clients without a burden on their own case service budgets.

(3) The Division has opened three technical aid centers for use by college students. The technical aid centers are resource rooms equipped with a collection of useful devices, most of which are too expensive to allow assigning individual units to each student. A typical technical aids center may include: an Optacon; a typewriter with Optacon attachment; a Vari-Speech II by the Lexicon Company; a talking calculator (Telesensory Systems, Inc.'s Speech Plus) or a scientific calculator produced through our laboratory; a Perkins Braille Writer; closed-circuit television magnifier system, usually Visualtek; recorded disc players; and large-type and other reference materials, such as a dictionary, atlas, etc.

We have had varying degrees of success with technical aid centers. The one located at the University of Kentucky is operated by our recording coordinator and housed in an area of the Student Center. It has been well used during the last few years by approximately 25 vision-impaired students at the university.

Our second technical aid center is located at the University of Louisville and is operated in a room shared with Recordings for the Blind, Inc. We do not provide staff at this center, and utilization of this center has been less than optimum.

Our third technical aid center is housed in a room of its own in the main building of Bellarmine College, a Catholic-supported college in Louisville. For approximately two years this room has been the standard hang-out of students interested in studying, drinking coffee, listening to the radio, etc. The recreational atmosphere does not seem to have interfered with the more serious purpose of this installation.

(4) For just over a year now, our Division has been engaged in efforts to modify a variety of existing equipment for use by the blind by interfacing various instruments with speech boards obtained through Telesensory Systems, Inc. We brought some of these devices with us so you could have an opportunity to examine them first-hand. Our talking calculator box is compatible with a variety of Monroe calculators. We have with us the fully scientific calculator, Model 1920. We have in the office a Model 1930, which is similar equipment that is programmed for business and statistics. By installing the proper receptacle on the back of the Monroe calculators, our talking box can be plugged into the one which most nearly meets the needs of our clients. These calculators may be obtained commercially from Westpro, Inc., 131 University Avenue, Lexington, Kentucky 40503.

We also have been successful in attaching speech output to some of the Tektronix Company's electronic equipment. We have here for your inspection a digital voltmeter capable of measuring a wide variety of electrical parameters and, by using a special probe, measuring Centigrade and Fahrenheit temperatures. The Tektronix counter which we have included in the package is a

very versatile instrument which can function as a talking stop-watch as well as measure frequencies of unknown signals, differences in sums of frequencies, and time lapses between events. Unfortunately, the Tektronix people have not yet standardized their data output configurations, so Tektronix equipment has to be interfaced on a custom basis for each model.

In addition to the speech output device, we have produced a small number of clocks, stop-watches and telephone monitors employing audio-tactile output. You will understand the audio-tactile output immediately if you have an opportunity to examine it first-hand, although I find it a little difficult to impart a true understanding of the system through a brief written description. Suffice it to say that the audio-tactile output consists of a metal plate bearing columns of braille digits. All of the digits except one in each column will be passive when touched by the finger tip. The one active digit in each column will cause a beep to be emitted when it is touched by the finger. When the user hears this beep, he knows to read the digit which he is touching and that this digit is a part of the displayed output of the device.

(5) Much of the foregoing has dealt with activities of our Division which are carried out in accordance with rather well-developed plans. The rest of our activities are a result of requests from the field to solve specific problems of blind individuals in work situations. The activities can best be explained by examples.

(a) At our Kentucky Industries for the Blind, sighted workers have been employed to perform packaging operations consisting of weighing nuts or bolts into the carton which is later sealed for distribution. The weighing method was used to avoid the tedious, time-consuming task of counting the parts. This is a standard procedure for many operations. A package containing the correct amount of hardware was placed on one side of a balance and an empty carton placed on the other. The worker's task was to place in the empty carton quantities of nuts or bolts until the balance was in a state of equilibrium. The Division of Special and Technical Services made a simple modification using a photo cell, a light and an audio oscillator arranged in such a way that when the scale was off-balance, an audible tone would be produced, and when equilibrium was achieved the tone would disappear.

(b) A young man with partial vision has a typing job with the Internal Revenue Service in Covington. He relies on the use of closed-circuit television to enable him to read the original of the material from which he types. For a long time he manually adjusted the table under the camera as needed. This arrangement proved to be very slow since the typist had to stop typing while using his hands to manipulate the closed-circuit television table. The Division motorized the table and provided foot controls so

that the typist can now manipulate the material at will without taking his hands from the typewriter keyboard.

(c) Recently a totally blind person was admitted to a training program to become a small appliance repairman. His instructor required that the student be able to solder and be able to measure several electrical parameters as well as temperature. The Division explored several techniques for soldering without sight, finally selecting two which, if used alternately for specific problems, seem to be entirely workable for the blind. One technique is based on a tweezer-like handpiece which grips the work to be heated between two pointed electrodes. Heat is generated when the device is activated by pressing the foot pedal. This handpiece can be replaced with a carbon tip and grounding tip set-up which constitutes the second configuration. This arrangement is very useful for soldering larger work of the kind which may be encountered in small appliance repairs.

The problem of measuring electrical parameters was met by providing the student with the Simpson Model 260 Multi-Tester as modified by Science for the Blind. We are currently making arrangements to make a similar modification for the Simpson 255 which will allow the student to measure temperature in several ranges up to 1000 degrees Fahrenheit.

In closing, I would like to express the hope that other states' rehabilitation agencies will initiate programs to stimulate the application of technology to the solution of problems relating to the employment of the blind. It is my belief that we have the responsibility to take the lead in this kind of applied research. For the same reason that the private sector explores research to find solutions to the problems which they face, state agencies must now accept the responsibility to solve their own problems. Much of what has been accomplished to date has been almost accidental in the sense that the technology was developed for other applications. We can no longer wait for serendipitous windfalls; instead, we should proceed with deliberation and purpose to overcome the countless problems which continue to frustrate the efforts of our blind men and women to enter the competitive labor market.

Kentucky-Developed Aids for the Blind

Audio-Tactile Devices

The Audio-Tactile (A.T.) display, designed in Kentucky, is a braille readout device that can be used to interface blind persons with any equipment having a digital display. It is the braille equivalent of the visual displays used for visual equipment such as wristwatches, hand-held calculators, etc. The Division of Technical Services has developed the following items:

- (1) Audio-Tactile Stopwatch (Range 0 to 59 minutes, 59 seconds)

This battery-operated stopwatch contains a power on/off switch and start/stop controls. It may be useful to blind persons in radio work and others who need to time tape recordings, measure pulse, and other applications where a stopwatch may be required.

- (2) Audio-Tactile Clock

This is a straight-forward 24-hour, six-column digital display clock continuously displaying hours, minutes, and seconds. It is appropriate in situations where extreme accuracy is required for measuring time to the nearest second.

- (3) Telephone Multi-Line Adapter

To eliminate the difficulties which a blind person faces when operating a multi-line telephone, the Division has designed an Audio-Tactile multi-line adapter compatible with any 6-, 12-, or 18-line telephone system. Corresponding with each lighted button on the telephone is a braille cell designating that specific line. When the telephone rings, the operator reads the braille keys. As each cell is touched, the adapter emits an audible tone which indicates the status of that line. A "busy" is signified by a constant tone, while an incoming call (usually signified by a blinking light) is represented by a corresponding series of tones. The entire unit is housed in a small box adjacent to the telephone. Since these devices are custom-made to suit the operator's specific need, there may be some variation in each device's design or operation.

Talking Devices

- (1) Monroe Model 1920 Calculator

This is a full, desk-top, scientific calculator with speech output from both the keyboard and display. Among its major features are:

- (a) Ten memories with full arithmetic capability
- (b) All trigonometric functions
- (c) Natural and common logarithms
- (d) Statistics functions (includes standard deviation)
- (e) Three levels of parentheses
- (f) Algebraic sequential calculating operation

This calculator would be useful to students with a major in mathematics, chemistry, physics, or other physical sciences or persons working in these fields.

(2) Tektronix Electronic Lab Equipment

The Division has designed a special modification for use with Tektronix which will give speech output to a variety of Tektronix equipment. This includes digital voltmeters (with temperature measuring capability) and electronic counters (with time measuring capability). This is "state of the art" electronic equipment of primary interest to students of electrical engineering and related fields. The equipment is available for loan or permanent assignment to blind engineering students or persons with specific employment opportunities in technical fields.

MAN-MACHINE SYSTEMS: THE IMPACT OF SOCIAL
AND BEHAVIORAL SCIENCES

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I would like to talk briefly with you today about the way in which behavioral sciences have joined forces with engineering and technology over the past several decades to help the human operate as a more effective component in various types of man-machine systems. In order to understand fully the role of the behavioral sciences in this important field, it is necessary to look briefly at the history of two important disciplines in our society: engineering and related fields of technology and the behavioral sciences.

In preparing for my talk today, I came across a definition of engineering as "The art of directing the great sources of power in nature to the use and convenience of man." Actually, this was a definition adopted by the Institute for Civil Engineering in London, England, in 1828. While today's definitions are somewhat more sophisticated, the basic concept of engineering remains the same. We commonly think of engineering as the application of the physical sciences to the solution of problems in the environment. We also commonly think of the behavioral sciences as dealing only with problems of human behavior in order to understand better how the human organism functions. The discipline of psychology has a brief history compared to engineering, being recognized as a science for only about a century.

While these two great disciplines are both aimed at improving the well-being of man, it was not until the past few decades that they formally joined forces to solve problems that neither discipline could deal with adequately alone. It was not until problems were encountered in the design of man-machine systems in World War II that these two important disciplines joined forces. During the early stages of the war, engineers had primary responsibility for the design and manufacture of systems for human use. Since these engineers were not trained in the behavioral sciences, they had only an intuitive understanding of how the human functions in complex man-machine systems. As a result, systems were designed that often proved to be failures. Sophisticated aircraft were designed which were involved in serious accidents because of what engineers called "pilot error." When the rate of these man-machine systems failures became alarmingly high, it was decided that perhaps specialists in human behavior should be called upon to assist in correcting the problems that were leading to these unreasonable failure rates. It was when this happened that we saw the birth of a hybrid profession known as "human factors engineering." The field of human factors engineering has two major components: the

professional fields of engineering and the scientific fields of the behavioral sciences, including psychology, anthropology, physiology, and sociology.

I would like to trace what I see as three distinct phases in the evolution of human factors engineering in the past three and one-half decades in an attempt to show where we are in this important field with respect to work for the blind. The first period that can be clearly distinguished might be called the period of "retrofit to original designs." During this period, which lasted through the 1940's, the human factors engineer was concerned primarily with modifying existing man-machine systems in order to improve the effectiveness of the human link in the systems. During World War II on one of the Pacific Islands, a fleet of new fighter aircraft had arrived and was on the flight line waiting to be checked out by the pilots. These particular aircraft were the same as had been flown by the pilots at this base previously. When a Japanese attack came the next morning, the well-qualified pilots attempted to take off in the aircraft rather than leave them vulnerable on the flight line. However, as the result of a complete redesign of the cockpit, not a single aircraft became airborne. Most of them were destroyed, and the few that were not avoided becoming casualties by being taxied around the airstrip in hopes of making them less vulnerable targets.

As the result of this and similar instances in aircraft design, psychologists readily recognized that standardization of cockpit design was a must if the systems were to perform effectively. As a result there was established an "aircraft cockpit standardized panel," representing the three services, which began the retrofit process of modifying cockpits for effective and efficient use by the human operator.

The second phase in the history of human factors engineering and its contributions to man-machine systems represents the period of the 1950's. It might be called the "knobs and dials" era of human factors engineering. During this period, when academically "respectable" psychologists were busy in their pristine laboratories studying such important matters as how to minimize the number of errors made by a rat in learning to run a maze, or what schedule of reinforcement leads a pigeon to continue pecking at a reinforcement lever the longest, those of us who dared dirty our hands by doing applied research on how man could adapt more effectively and efficiently to his environment were given the pejorative title of "knobologists." It is true, in retrospect, that some of the studies of this era seem rather simple-minded. It is also true that these simple-minded studies made significant contributions to improved man-machine systems design.

While retrofit problems were still being dealt with, the behavioral scientist recognized that he could make a contribution to the original design of man-machine systems by studying the human's ability to process information through various sense

modalities. Through studies done in the late 1940's and early 1950's it was found that a major cause of non-fatal aircraft accidents and near misses was inaccurate reading of instruments, in particular the altimeter. In querying pilots regarding non-fatal accidents and near misses, it was found that a large proportion of them were attributable to incorrect readings of the altimeter by one thousand feet. While an incorrect reading of an altimeter on the approach to a runway of ten feet, or perhaps a hundred feet, might be a tolerable and correctable condition, misreading an altimeter by a thousand feet can get one into serious trouble.

As a result of problems such as these, the behavioral scientists turned attention to the design of better instruments and controls to permit the operator to function as a more effective link in the man-machine systems. It was during this period that many volumes of human factors data, handbooks comparable to those used by engineers for decades, were published. These volumes dealt with the best design of various types of instruments, the best design for pointers and the graduations on the instruments, and the best design of tactile displays that permitted the operator to differentiate among controls by "shape coding" them to minimize errors in identifying controls. Prior to this it had not been uncommon for a pilot to confuse the "flaps down" and "landing gear up" controls because of the similarity in their shape and location. Studies were also undertaken to see what the frequency and sequence of use of various instruments and controls in the cockpit were so that the most critical could be placed in a position that led to the smallest degree of effort on the part of the pilot and, therefore, fewer errors on his part.

While these studies made significant contributions to the advancement of man-machine systems design, they still fell short of the ideal. They still focused on isolated behaviors of the human operator rather than on the operator as an integral part of the system. It was not until the late 1950's and 1960's that the "systems approach" to the human being in man-machine systems really began to take hold. The notion that the engineer and behavioral scientist should begin from the inception of a new system to work on its design represents the third phase in the evolution of human factors engineering, a phase that might be designated the "systems approach phase." Undoubtedly, the greatest single boost to this new approach of considering man as an integral part of a total system came from the space program. When, in 1961, President John F. Kennedy announced that we were going to the moon and that the necessary resources to put a man on the moon would be made available, the field of human factors engineering began its greatest advance in its brief history.

In the early 1960's with the advent of the man-machine systems concept, it was thought that man could be described mathematically as a component in this system. Indeed, behavioral scientists studied the functioning of the human link in man-machine systems with the notion that they could write an equation

that described his performance much as an engineer could write an equation that describes the function of a shock absorber on an automobile or a particular control device on an aircraft. Behavioral scientists called this the "human transfer function." The notion was that if a human transfer function could be written, perhaps man could be replaced by a "black box" that could do the job as well or better.

After considerable investigation into this problem, it was discovered that there is no single human transfer function--that man does not always perform in precisely the same predictable way. To draw an analogy from computer sciences, man functions in many different ways, and the unique contribution that he has to make in the system is that he is capable of instantly "reprogramming" himself to meet the conditions that occur. We can write an equation that describes man's performance in driving an automobile along a superhighway. But this equation does not describe his performance when a car suddenly cuts in front of him. He has essentially reprogrammed himself to behave in a way most appropriate for the circumstances. It is not possible to write equations that will adequately describe all the contingencies that may arise in the operation of a man-machine system. So the behavioral scientist gave up the notion of a human transfer function where the system required adaptation to a wide variety of environmental conditions.

This should not really surprise us since we have seen similar things in other areas. When Sidney Pressy developed the first teaching machine in the early 1930's, a machine that now rests in the Smithsonian Institute, many educators feared that the human being would be replaced in the classroom by a teaching machine. This did not occur because of the unique capability of the human being to function under unanticipated circumstances. When, in the 1960's, educators began to get interested in the digital computer as a method of assisting students to learn, many educators feared that their jobs would be gone because computer-assisted instruction would replace them in the classrooms. Much money was devoted to the development of computer-assisted instruction, and while it undoubtedly has a place in certain learning situations, it has not and will not replace the human being in the system.

It was often the case in the early days of the Apollo project in the early 1960's that the behavioral scientist was significantly ahead of the engineer in attempting to resolve problems of the human component of space systems. Questions of the operator's ability to function in a complex system were being raised by the behavioral scientist before the engineer had completed even preliminary designs of the system. For example, prior to the design of the lunar excursion module, psychologists were studying the amount of information that the astronaut had to have in order to fly safely the projected course from the orbiting Apollo spacecraft. Since the pilot was flying a vehicle in no atmosphere and greatly reduced gravity, it was impossible to know from our experience with conventional aircraft what kind

of performance could be expected of him. To deal with this problem, psychologists and engineers attacked it even before the craft itself had been designed. Using a simulator backed up by a large bank of analog computers in Columbus, Ohio, psychologists designed different instrument panels that varied in terms of the amount of information available to the pilot for landing the vehicle. The amount of instrumentation was critical because the more information required by the pilot, the greater the weight of the computers and associated equipment that had to be carried aboard the lunar excursion module, and, therefore, the less fuel available for the descent and ascent. It was found that our astronauts and even test pilots were able to learn very rapidly to function with minimum instrumentation in this situation.

In another instance behavioral scientists began a study of abort decision-making criteria that had to be established for the entire Apollo mission even prior to the design of the vehicle itself. The question was, basically, "What are the critical stages in the mission during which the crew would be faced with the decision of aborting the mission, and what kind of information would be required by the crew at each point in time in order to assist them in making this decision?"

Also, psychologists were studying the role of the "third man" in the vehicle. The decision had been made that the crew should consist of three astronauts. Obviously, one was to be the command pilot and another essentially a co-pilot. No one had bothered to specify what the precise role of the third man was to be, other than to say that he was to perform some sort of scientific tests. Before preliminary design criteria for the spacecraft were established, psychologists were traveling throughout the country interviewing geologists, astronomers, and other scientists to establish selection criteria and training requirements for the third crew member.

It can be seen, then, that the behavioral sciences over the past several decades have made significant contributions to the design of more effective man-machine systems. Unfortunately, we do not see parallels in the area of work for the blind that we can be proud of. In fact, I would suggest that at best we are only dabbling in the retrofit stage in dealing with man-machine systems designed specifically for the blind and visually impaired. I would even say that we are not doing a very adequate job of that. We may point to isolated instances in which an agency has modified a job station for performance by a blind or visually impaired client. Nevertheless, these instances are few, even though one of the biggest barriers that face those of us in work for the blind today is the fact that the man-machine systems available for human beings to earn a living and make a contribution to society and to their own well-being have been designed for the sighted operator.

I see impressive retrofit improvements being made to assist some handicapped individuals to accommodate more adequately to the world in which they live. For example, ramps

are being added to existing buildings to provide access for people confined to wheelchairs. Nevertheless, it is possible for a blind person to walk down the halls of that same building and injure his head on a fire extinguisher or some other device that an architect, fire marshal, or OSHA official says must be there. Again, I would emphasize that we are not even doing an adequate job in the area of retrofit for the blind and visually impaired.

Perhaps we are making modest progress in providing retrofit solutions to existing systems designed for the sighted in some areas. For example, using an inexpensive labelmaker we can attach braille labels to the various controls on an electric stove that will permit the blind person to use it safely. But when are we going to begin addressing the question of the entire home as a system which might have entirely different design criteria for the blind person than for the sighted person? It is entirely possible that the entire style of living for the blind person might dictate a totally new design in home construction than the typical three bedrooms, two baths, living room, family room, and large kitchen which are the mode for sighted individuals. Patterns of social behavior such as entertaining friends, recreational activities and hobbies, and meeting what we often refer to as "demands of daily living" could well set forth design criteria which would result in a home unlike anything that presently exists and which none of us have even conceived. It is when we reach this stage in applying the principles of man-machine systems engineering to the problems of the blind that we will have made the transition from the "retrofit" stage that we are presently in to the "systems design" phase.

How do we move ahead to the "systems design" phase of designing optimal man-machine systems for the blind? Much of the research and technology is already available to us. However, a great deal of additional research will be required. All of this takes resources--qualified manpower, sophisticated research facilities--most of all, it takes money. Since I am a psychologist and not an administrator who controls the purse strings, I will not try to answer the question, "Where do we get the money?"

To be sure, I want to recognize the important contributions that have been made in technology for the blind. The Optacon, talking calculators, electronic canes, and similar devices represent significant contributions to work for the blind. However, I would like to challenge you that these contributions represent isolated instances often falling in the phases of "retrofit" and "knobology." I would like to leave you with the thought that if work for the blind is going to make significant contributions to the welfare of the clients of those of us who are attending this conference, we have to move ahead into the "systems design" phase in which entire systems are designed for the operation of a blind or visually impaired person as an integral component of the system. We do not have at our disposal the resources that so effectively helped us adopt this concept of man-machine systems in the 1960's and to put a mar on

the moon. Nevertheless, we are making a beginning. Conferences such as the one we are now attending give me a feeling of great satisfaction that we are moving in the right direction in technology and work for the blind.

Suggested Readings

Human Factors Engineering by Earnest J. McCormick, McGraw-Hill, New York.

Biotechnology: Concepts and Applications by Lawrence J. Fogel, Prentice-Hall, Englewood Cliffs, New Jersey.

Applied Experimental Psychology: Human Factors in Engineering Design by A. Chapanis, W. R. Garner, and C. T. Morgan, John Wiley and Sons, New York. (Primarily of interest because this is the first book written on the topic of Engineering Psychology.)

TELECOMMUNICATIONS AND VOCATIONAL REHABILITATION

Marcel J. Zobrak
Carol A. Paquette
Friend L. Skinner

METREK
McLean, Virginia

Introduction

In Bethesda, Maryland, there is a 47-year-old man severely handicapped with cerebral palsy. Because of his handicap, he had never been gainfully employed prior to this year. Now, like most other men his age, he goes to work every morning. He is employed as a computer programmer. Much of his training was accomplished at home through the use of a remote terminal connected via his telephone to a computer several miles away.

In Amherst, New York, there is a profoundly deaf 11-year-old with emotional problems. In her earlier years, she often pounded her head against walls and even windows. Now, she diligently sits in front of her television set at home and improves her knowledge of English, mathematics and social studies through a computer-controlled interactive television system that serves her and 13 other handicapped children in the area. Her teacher at school attributes a marked improvement in educational performance to the interactive TV system. The probability that this child will lead an enjoyable and productive adult life has increased substantially.

These examples are but two of a growing number of existing and potential applications of telecommunications technology to vocational rehabilitation. To some extent, Congress has recognized this potential. In the Rehabilitation Act of 1973, Congress expanded the scope of covered rehabilitation services to specifically include "Telecommunications . . . aids and devices."

Responding to the congressional mandate, the Rehabilitation Services Administration (RSA) initiated a series of research projects aimed at helping the states realize the potential benefits of using telecommunications technology in delivering and administering vocational rehabilitation (VR) services. Preliminary results from one of those projects are presented here.

The project focuses on the problem of overlapping efforts by states engaged in producing recorded material for use in VR which can be transmitted via telecommunications systems, and upon the inadequate mechanisms for distributing such material among the states. The material, frequently referred to as "software," can be recorded on various media. Examples are electronic voice signals on audio-cassettes, TV signals on videotapes, computer

programs and data on magnetic disks, etc. More specifically, two questions are of particular concern to RSA:

1. Is there a need for, and is it feasible to establish, a self-sustaining organization to coordinate and facilitate production and distribution of VR software?
2. If so, then what structure should such an organization have?

To answer these questions, several data-gathering activities had to be included in the project. The data describe the kinds of telecommunications systems available to VR agencies, the kinds of devices, or end instruments, which can be attached to telecommunications systems to facilitate system use by handicapped persons, the kinds of software available, and the types of VR services to which they can be applied. As such, the data are not only useful for the organizational study, but also directly useful in their own right to states interested in building their VR capacity through existing telecommunications technology and to the VR community at large.

The preliminary results fall into four categories: Applications, End Instruments, Software, and Organization.

Applications

There exists today a variety of ongoing applications of telecommunications in VR. Three general observations can be made about these applications. First, by encompassing conventional as well as innovative uses of the telephone, television and radio, they represent almost a full spectrum of telecommunications services available today. Second, they are relatively few and far between in a geographic sense. And third, they are arising with increasing frequency. The following examples, some of which are drawn from a companion project being performed for RSA by the Office of Telecommunications of the U. S. Department of Commerce, are illustrative.

In Michigan and Nebraska, a teledictation system is utilized to speed processing time for disability determination. A toll-free telephone number connected to an automatic recording device is available 24 hours a day, seven days a week. Physicians can use this system to phone in their medical evaluations. The result is a 10- to 15-day reduction in processing time. Nebraska has experienced an unanticipated cost savings in that some physicians charge less when they do not have to use their own staff time to prepare evaluation reports. It has also been found that some physicians who, in the past, would not examine VR clients because of the paperwork, are now willing to participate.

Telephone conferencing, a service which permits more than two individuals in different locations to be included in the same conversation, is also being utilized. In Wisconsin and

Minnesota, conference calls between the state office and district offices are used to discuss administrative matters. Similar calls have been made between RSA regional offices and state offices in Regions IV and V. Many believe that with some care in agenda preparation, telephone conferencing has great potential as a substitute for travel to, and conduct of, face-to-face group meetings.

Another telephone-oriented application gaining increased use in VR is teleprocessing. Teleprocessing is simply interacting with a computer via a remote terminal connected to the computer by a communications link. A teleprocessing application with great potential is client and management record-keeping. In most states, VR agencies use the state government's central computer in what is called the "batch" mode. This is a mode of processing in which input information from the VR agency is sent by mail to the computing facility, processed, and the resulting reports sent by mail back to the agency. Turnaround time is measured in days, and sometimes weeks. In Montana, however, six remote computer terminals have been made available for VR agency use. The terminals are connected to the state's central computer via the state's telephone system and can be used to update client and management data and to obtain reports. Turnaround time is now measured in minutes.

Along another vein, paraplegics, quadriplegics, and legally blind students at the Center for Independent Living in Berkeley, California, have learned to become computer programmers. Remote computer terminals enable the students to access a computer located on the campus of the University of California at Berkeley, as well as a computer at the Del Monte Corporation. Local business concerns have actively participated in the course design and are now employing the graduates, who range in age from 25 to 45. This represents the first employment for some of these students. The courses are sponsored by the California State Department of Rehabilitation.

Computer-aided instruction (CAI) is another form of teleprocessing with significant potential in VR. At Golden West College in Huntington Beach, California, students can learn AMESLAN, the American Sign Language of the Deaf, with the aid of CAI. By typing in the English word or phrase at the terminal, the student activates his local microfiche file which is driven by the college's central computer. A drawing showing how to make the corresponding AMESLAN sign for the word flashes on the terminal's screen in seconds. The system can also be used in reverse so that the student can test himself. Forty-nine separate lessons, including 660 signs corresponding to frequently used words and phrases, are available.

The 11-year-old deaf girl in Amherst, New York, mentioned earlier, uses a variation of CAI known as TICCIT (Time-Shared, Interactive, Computer Controlled, Information Television). TICCIT's small central computer is connected to home terminals via the area's cable television and telephone systems. The

homebound handicapped students using the service can interact with a wide variety of CAI programs in the computer or they can select a variety of educational videotaped programs for viewing and listening. The home terminal consists of a standard home television set augmented by a cable television converter, a keyboard, and a coupler for connecting the keyboard to the telephone receiver. Total cost of the latter three items is less than \$300. If and when two-way cable systems become a reality, the telephone link between home and computer can be eliminated.

Interactive cable television is also being used experimentally in Peoria, Illinois. There, RSA is supporting a demonstration of interactive cable television as a medium for training homebound VR clients to be insurance claims representatives and as a medium for improving their ability to perform activities of daily living.

According to the Department of Commerce's Office of Telecommunications, use of commercial and educational television by state VR agencies is also growing. Through public service announcements, commercial TV is widely used for public information and occasionally used to enhance the VR functions of referral, job placement, and follow-up. Educational TV, on the other hand, is used to augment a wider range of VR functions: public information, referral, guidance and counseling, client training and education, job placement, follow-up and staff training. At least seven state VR agencies are utilizing educational TV for such purposes.

Instructional Television Fixed Service (ITFS) is another form of television which might be beneficial to VR. ITFS stations are typically licensed to educational institutions and their primary use must be the transmission of instructional materials. A single station may be assigned up to four channels and can, therefore, transmit up to four different programs simultaneously. Transmission range is limited to about 10 miles. ITFS receivers require a special type of antenna and a converter. At least three state VR agencies are planning to use existing ITFS systems for training and educational activities.

Radio, the remaining primary telecommunications medium, is also being utilized more and more in VR. Commercial and public (educational) radio are used by some agencies to augment their public information, referral, job placement and follow-up activities. Public radio is also being used for client guidance, counseling, training and education in several states. But perhaps the most effective use of radio in VR lies in the use of the Subsidiary Communications Authority (SCA) subchannels of FM broadcast stations. Every FM station is allowed a subchannel over which it can broadcast a program totally separate from that on its main channel. Groups in at least 11 cities are now using SCA subchannels to provide blind people with talking book information. Groups in at least nine more cities are planning similar services. In addition to talking books, the daily newspaper, magazines and consumer ads are read, and some VR

services are provided in some cities. VR agencies in eight states are known to be utilizing this medium.

End Instruments

One of the problems many handicapped people have in using telecommunications systems is an inability to use standard end instruments such as the telephone, television set, computer terminal, etc. Yet more and more, we read or hear about specially-designed or modified devices which enhance the abilities of persons with communication or physical disabilities to access telecommunications systems. To bridge the gap between those who know about such devices and those who should know about them, a catalog of end instruments is now being assembled. The catalog, which is expected to receive wide distribution, will be organized in an easy-to-read format. On one page will be a photograph or drawing of the device, together with a brief discussion about its application and operation. On the facing page will be pertinent data about the device's technical and physical characteristics, its cost, availability and supplier.

Catalog data were collected through a letter survey of manufacturers and research laboratories and researchers. Although the survey uncovered approximately 70 different end instruments, only about 50 descriptions will appear in the catalog. The difference arises from the fact that some devices are sufficiently similar to each other to permit aggregation into a group or class which can be accurately portrayed by one description.

Some examples of devices relevant and familiar to blind persons are the OPTACON, VISUALTEK, and the Kurzweil translator which converts printed text to speech. Other, perhaps less familiar, examples are VDETS, AUTOCOM, the Micon terminal, and OCCUR. A brief description of the latter four will give an indication of the variety of devices available.

VDETS is an acronym for Voice Data Entry Terminal System. It is a device that converts spoken words to computer-readable code, thereby offering many handicapped persons a mode of data entry or machine control which otherwise is not available. Input may be in the form of words or short phrases, and output is a standard computer code. Users must first "train" the system to understand their voice by repeating each word in the vocabulary several times and identifying the word each time. Vocabulary size is limited to approximately 300 words at present. VDETS recognizes speech of any speaker regardless of vocabularies, dialects, languages, accents or acoustic environments. It is currently being used in several places to train handicapped persons to become computer programmers.

AUTOCOM is an acronym for Auto-Monitoring Communications Board. It enables physically handicapped individuals with sporadic or uncoordinated arm movements to communicate with a computer and, through the computer, with other persons. With

AUTOCOM, the user need not push or pull any levers, buttons, or switches. He need only slide a magnetic pointer over a lapboard to the vicinity of a desired letter or number on the board, and hold it there or let it rest for a short time. After an elapsed time interval, which is adjustable, a switch closes and a signal indicative of the letter or number is sent to the computer.

The Micon terminal is a compact, lightweight, highly portable device which enables deaf persons to communicate with other deaf and non-deaf persons via the telephone. It is typical of several devices with almost identical communications capabilities. It consists of a keyboard, a one-line, 32-character electronic visual display, a telephone receiver interface and the necessary electronics--all contained in a case which is eight inches by ten inches by three inches in size and weighs less than four pounds. Deaf persons merely use their telephone to dial others who have an identical or similar device (e.g., a standard teletypewriter). They then place the telephone receiver on the device, and are ready to communicate via the keyboard and display.

OCCUR is an acronym for Optical Controlled Communication Unit for Rehabilitation. It is a compact experimental device for controlling a teletypewriter or similar device via a light pen mounted on a pair of eyeglasses. A letter, number or symbol can be selected by moving the head and pointing the light beam for a predetermined time at the proper place on a small panel situated in front of the user. The teletypewriter will then be commanded automatically.

In addition to describing such end instruments, the catalog will classify them in several ways. One classification will be based on required user ability--using the five abilities of sight, speech, hearing, movement, and touch. Considering sight, hearing, and touch to be user input abilities and speech and movement to be user output abilities, there are about 17 combinations which are meaningful for personal communications. Table 1 lists these combinations together with the corresponding number of devices which require a particular combination of abilities. It appears that at least one device is available for all but one of the reasonable combinations. The combination for which a device was not found is "speech, movement, and touch." However, several devices could be paired, if necessary, to serve a person having only such abilities. It should be noted that many of the devices can be used in different ways. Since such devices are counted more than once in Table 1 and in subsequent tables, the total number of entries exceeds 50.

Table 1
Number of End Instruments Requiring
Various User Abilities

Required User Ability	Number of Devices	
	Attendant Needed for Set-Up	Completely Unattended Use
Sight	9	3
Speech		1
Hearing	4	5
Movement		2
Touch		2
Sight, Speech	1	
Sight, Hearing	3	
Sight, Movement	1	24
Speech, Hearing		3
Speech, Movement		1
Speech, Touch		1
Hearing, Movement		8
Movement, Touch		4
Sight, Speech, Movement		1
Sight, Hearing, Movement		5
Speech, Hearing, Movement		4
Speech, Movement, Touch		0

Tables 2 and 3 show two other classifications made of each device along with the number of devices in each class. Table 2 shows function served, while Table 3 shows availability. In Table 2, it should be noted that the device function is stated relative to the telecommunications link rather than the user. Also, the "store" class refers to devices which place information on, or retrieve information from, a storage medium. Examples are audiotape and videotape recorders and players. In Table 3, the "potential" class refers to devices which are not yet known to exist but which the project staff felt could be developed and might well be beneficial.

It can be concluded from the end instrument data that many devices exist to enable a wide range of handicapped persons to utilize telecommunications systems effectively. This is not to say that additional research and development are not needed. As technology advances, improvements and entirely new approaches will undoubtedly be possible and should be sought.

Table 2

Number of End Instruments by Communication Function

Function	Number of Devices
Send	13
Receive	12
Send and Receive	16
Amplify or Convert	4
Store	10

Table 3

End Instrument Availability

Availability	Number of Devices
Commercial	40
Laboratory or Special Order	7
Potential	3

Software

Many telecommunications applications require transmitting recorded material, frequently referred to as "software." As indicated earlier, software can be recorded on virtually any medium. Examples are voice signals on magnetic tape and digital data on magnetic disks. In general, software of high technical and content quality is expensive to produce. It is not unusual to spend \$50,000 to \$100,000 to produce a well done, broadcast-quality, one-half hour videotaped program. Several years ago, a one-half hour "Sesame Street" program was reported to cost \$50,000. Well done talk shows can cost from \$5,000 to \$10,000 per half hour. A recent update to the VR film "What Finer Art" has reportedly cost \$65,000.

The need for quality software in VR, coupled with high production costs and with suspected uncoordinated and overlapping production efforts, suggested that a survey of VR software be conducted. The survey encompassed all state general VR agencies, the 27 separate state agencies for the blind, 19 RSA research and training centers, 25 professional and consumer groups, ten software clearinghouses, and all state agencies concerned with mental health and retardation, vocational education, aging and corrections. By design, the survey excluded three classes of software which to some degree are useful in VR. One is the body of medically oriented software produced in the nation's medical schools, and another is the body of computer software which might be beneficial in managing and administering the VR program. A limited budget necessitated these exclusions. The third class was the body of talking book software available through the Library of Congress and Recordings for the Blind. It was excluded because present production and distribution are adequate.

Overall, the response was good for all but the state agencies concerned with mental health, vocational education, aging and corrections. Typically, the general VR and the blind agencies responded with listings of their holdings. These appeared to be prepared in response to our query. Ten agencies, however, responded with catalogs that were available for distribution, typically within the state. Other organizations responded with catalogs or they referred to catalogs which described their holdings.

Looking at the general VR and blind agencies, 46 (87 percent) general and 16 (63 percent) blind agencies responded. Table 4 shows the nature of their responses. It is worth noting the difference in number of agencies with a catalog (13) and the number without (49). To some extent, this can be viewed as a direct indicator of the degree to which software use has been formalized in state VR agencies, and perhaps as an indirect indicator of the use of telecommunications.

In all, the VR agencies reported 580 unique software titles. Of these, 520 contained sufficient information to be usable by the project. Of the 520, 348 were described in nationally available catalogs, and the remaining 172 were classified as "fugitive" titles. Typically, fugitive titles have been produced by state agencies, largely for internal use, and are not generally available outside the state because of insufficient financial resources required for duplication. There is little doubt, however, that in those cases where clearances from persons appearing in the productions are required and have been obtained, the software masters could be made available to a distributor serving the VR community.

Table 4

Types of Software Survey Responses from
State VR Agencies--General and Blind

Type of Response	Number
No Materials Reported	6
Rehabilitation Agency Listing	43
Parent Agency Catalog	3
Rehabilitation Agency Catalog	10*

*The ten agencies having their own catalogs are Alabama, Georgia, Idaho, Iowa, Michigan, North Carolina, Ohio, Oklahoma, Utah, and West Virginia.

Another indicator of software and telecommunications use in VR is the distribution of the number of titles held by state agencies. Table 5 shows this information. The fact that half the agencies report holding fewer than ten titles suggests that use of software and of telecommunications systems has substantial room for progress. On the other hand, the fact that two states report more than 100 titles can be viewed as an indication that use of software in VR is beneficial and probably worth encouraging.

Table 5

Number of Software Titles versus
Number of State VR Agencies

Number of Titles	Number of Agencies
0	6
1 - 5	15
6 - 10	9
11 - 50	18
51 - 100	12
101 +	2*

*Alabama and Utah.

It is interesting to examine the reported titles in terms of the sources from which the agencies obtained their copies. In all, 177 different sources were reported, suggesting that there may be a need for a single, central group or organization which contacts these sources, reviews and screens their information, and disseminates the results to the VR community. Table 6 shows the various classes of software sources and the percentage of all titles reported. Commercial sources, followed by the VR community itself, appear to be the largest source group.

Table 6
Sources of VR Software

Source	% of All Titles
VR Community	25
Professional and Consumer Groups	8
Universities	8
Federal (Not VR)	5
Commercial	32
Other and Undetermined	22

An analysis of the intended audience of the software is also enlightening. Table 7 shows this information. It should be kept in mind that some titles are aimed at multiple audiences and, therefore, are counted in more than one category. Perhaps the most striking result shown in Table 7 is the apparent absence of client-oriented materials. To some extent, the low value of 17 percent is caused by the fact that only agencies and not facilities were surveyed--although the agencies were requested to provide information on facility software holdings as well as their own.

Table 7

Target Audience of VR Software

Audience	% of All Titles
Agency Administrators	15
Consultants and Referral Agencies	6
Counselors	49
Clients	17
Employers	5
Facility Administrators	9
Facility Staff	38
General Public	18

It is also interesting to note the types of media upon which the reported materials are recorded. Table 8 shows this information. The increase in videotapes and decrease in films when viewing the fugitive media relative to all media is noteworthy. It reflects the declining cost and increasing availability in the VR community of videotaping and playback equipment relative to that of comparable motion picture film equipment.

Based on the survey and upon discussions with VR personnel in the course of the survey, a number of preliminary conclusions can be drawn. With respect to software acquisition:

1. Sources of information are many and widespread.
2. There is no quality filter to guide software selection and such a filter is desired.

Table 8
Recording Medium of VR Software

Medium	% of All Titles	% of Fugitive Titles
Audiotape	16	9
Film	54	25
Filmstrip	3	3
Slides	2	3
Slide and Tape	4	12
Videotape	21	48

3. A standard indexing method for VR software does not exist and is needed.
4. VR personnel in a position to decide on software matters are frequently unaware of its potential and its limitations.

With respect to software usage, the following can be concluded:

1. Overall, state agencies make little use of software.
2. Software use is not formalized.
3. In total, state agencies produce (pay the cost of) only a few of the titles used by the VR community.
4. Joint production efforts on the part of state agencies do not exist.
5. There is little sharing of state agency-produced materials.

All of the preceding results and more are being documented in two reports which, hopefully, will receive wide distribution. One report describes the survey and its results, while the other is a catalog. The catalog will describe the fugitive materials, index them in several ways, and list the sources of all other catalogs acquired in the survey which have software with potential application in VR.

Organization

Judging from the preceding material, there is little doubt that the use of telecommunications is gradually taking hold in VR. However, relative to uses being made and tried in the fields of education and medicine, the field of vocational rehabilitation is somewhat behind. This fact, combined with the software survey results and conclusions, and with the high cost of producing high-quality software, leads to a list of needs which might well be best addressed by a special purpose organization.

To help the states, and the VR community in general, take full advantage of existing telecommunications systems, the project studied the kinds of services such an organization might provide and the structure the organization might assume. In the interest of brevity, only a summary of the considerations, results and conclusions to date is presented here. They are truly preliminary and are presented only to show the nature of the work being performed.

Regarding services, the following were considered:

1. Software information dissemination
2. Software quality assessment
3. Software distribution
4. Consultation
5. Software needs assessment
6. Software production plan dissemination
7. Software production facilitation
8. Software production

Information dissemination encompasses the activities of information acquisition and cataloging, and it includes dissemination via newsletter, catalog, and response to mailed or telephoned inquiries. Quality assessment includes brief evaluations by users as well as comprehensive evaluations by panels of experts. Under distribution, the organization would inform users where a particular software title might be obtained and it would offer to obtain a copy for them, leaving the choice to the user. Under consultation, a series of seminars would be prepared on telecommunications systems, equipment and software, their costs and benefits, and methods of integrating them into the VR process. The seminars would be conducted periodically in each HEW region and in conjunction with several national meetings of national VR organizations. This service would also advise RSA on telecommunications research and development needs and serve as an advocate of telecommunications for the handicapped. Software needs assessment is merely the polling of the VR community via the newsletter and the seminars to find out what kinds of new software might be beneficial, and then disseminating the findings to producers. Production plan dissemination takes another step. It involves finding out what individual software producers are planning or contemplating and disseminating that information to all producers in the hope of stimulating joint efforts and cost-sharing. Under production facilitation, the organization would

take an active rather than passive role in bringing prospective producers together. It would help them secure funding, arrange and conduct meetings and provide any legal advice that might be required to establish cooperative production efforts. Under production, the organization would manage the complete production effort, contracting for all services needed.

Both the project staff and the project's Advisory Task Force, which is composed of knowledgeable members of the VR community, believe that all the services are necessary, but that any organization set up for their delivery should implement them in a staged or gradual sequence. Furthermore, the production effort should be low-key and concerned only with relatively simple jobs. Larger productions are better handled by the expert teams that already exist.

Regarding structure, the following questions were considered:

1. What should be the nature of the operating entity? Should it be governmental or non-governmental? Should it be newly created or can an existing organization do the job? Should it be incorporated or unincorporated?
2. From what sources should it derive its revenue?
3. Should it have members who pay dues and who have a voice in its operation?
4. To whom should services be available--to members only, or to anyone willing to pay the service fee?
5. Should the organization's facilities be centralized or decentralized?

Analysis indicates that, on balance, a centralized rather than decentralized organization is likely to be more cost-effective. The small increase in effectiveness which a decentralized organization achieves by being closer to those in need of its service is more than offset by the added costs of communications, facilities and staff, and the ineffectiveness stemming from insufficient internal communications.

The analysis further indicates that there is no reason to restrict membership, service availability, or revenue sources, and that there is at least one reason not to restrict them--they can provide needed revenues.

Not surprisingly, a non-governmental organization is likely to be less costly than a governmental one--primarily because of higher governmental overhead rates. Within the overhead rate, the higher fringe benefit rate of government personnel is a key factor. Fringe benefits include such items as vacation time, sick leave, insurance, pension, etc. According to the latest results of a continuing Bureau of Labor Statistics

study, cost of fringe benefits for federal employees is 37 percent of the cost of regular, straight-time wages. In the private, non-farm sector, the comparable rate for non-manufacturing office employees is approximately 25 percent.

Somewhat surprisingly, it appears that a newly created organization, dedicated to the task of providing the specified services and only the specified services, is likely to be less costly in the long run than contracting for the services with an existing organization. Other activities of an existing organization will, in all likelihood, necessitate a more complex management structure, the cost of which will show up in a higher overhead rate. The overhead rate of a new and dedicated organization could be in the range of 45 to 50 percent of direct labor costs, whereas that of an existing organization will be in the 55 to 95 percent range.

Assuming the full complement of services is provided nationwide, annual operating cost would be in the \$350,000 to \$400,000 range. This would be offset by fees for service estimated at \$175,000 to \$225,000. It is likely, therefore, that approximately \$200,000 per year would be required to support the non-revenue-producing services of the organization (e.g., information acquisition, quality assessment, consultation, etc.). Although a portion of the deficit might be offset through mark-ups on the revenue-generating services and through grants from foundations, the bulk must undoubtedly come from membership fees.

Would the VR community provide such financial support? Perhaps it would, but certainly not to any substantial degree until after it has had time to sample the services and to evaluate their utility. What is needed is a trial of sufficient duration to allow the organization to develop its services, to offer those services nationwide, and to allow the VR community time to respond. Such a trial will require approximately one million dollars for start-up expenses and operating deficits over a four- to five-year period before sufficient financial support from the VR community at large can be expected.

While the return on this investment is difficult to quantify at this time, it can be examined qualitatively. At a minimum, the gap that now exists between the potential benefit of applying telecommunications in VR and the benefit currently being achieved will be narrowed. Also, the day when that gap is closed completely will have been substantially hastened. The implication of these results is that more handicapped persons, many who were heretofore termed "not eligible" for VR because of the severity of their handicap, will receive VR services, and the quality of those services will have been substantially improved.

COMMUNICATIONS TECHNOLOGY FOR THE BLIND:
AN OVERVIEW

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Introduction

The central goal of blind and visually handicapped citizens today is to become fully participating members of society. This involves being economically self-supporting, mobile, and able to care for such diverse needs as housekeeping, shopping, and participating in community affairs and social intercourse by being able to talk with neighbors about what is currently in print. A national emerging trend toward achieving this goal is for blind and visually handicapped children to remain in their local public schools and to be educated along with their sighted peers rather than to attend state boarding schools for the blind; but in North Carolina this process is slow. In North Carolina the Division for Services for the Blind assists blind and visually handicapped citizens to become economically self-supporting through its business enterprises section and other types of assistance. Through orientation training and mobility training or, in the case of some individuals, through the use of guide dogs, independent mobility can be developed by the blind.

Access to the daily stream of communication is also necessary for full participation in society. Despite the impact of radio and television, the printed medium is still the dominant channel for detailed and specialized information. Newspapers not only provide detailed news stories about international, national and local events, but also print such diverse material as editorials, recipes, fashion news, sports news, classified ads, grocery advertising, comics, obituaries, features by columnists, etc. Magazines are edited for about every conceivable interest: sports, organic gardening, women's lib, politics, etc. Books provide entertainment, information, and inspiration not found elsewhere. All this is familiar to the sighted individual. Without some parity of access to printed material by the blind and visually handicapped citizen, full participation by these individuals is severely hampered.

The blind and visually handicapped have a need for additional specialized information. This includes knowledge about the variety of social and rehabilitation services available to meet their particular needs. Those individuals who have recently lost their sight need both mobility and orientation training as well as psychological support.

Individually Controlled Systems and Technologies
for Reading by the Blind

The ultimate reading goal of any visually handicapped person is to achieve total independence and privacy. Through the years various attempts have been made to provide access for the blind to the world of print. Braille allows the reader ready, convenient and personal access to printed material. However, braille manuscripts are bulky, difficult to carry around and to handle, and expensive. It is not yet possible to distribute daily newspapers in braille to a wide audience. In addition, it requires extensive training to learn to read braille and not all people have the tactile sensitivity to feel braille, such as persons with infirmities resulting from diabetes or old age. The Library of Congress and the various regional libraries (including the North Carolina State Library for the Blind and Physically Handicapped) distribute a wide collection of recorded books on disc and cassette and also some recorded weekly or monthly magazines. These recordings are convenient and easy to use and they can be played at a convenient time and place. It is not possible, however, for the libraries to provide perishable material such as that found in newspapers and many magazines.

Some of the systems already in use, while providing the blind reader with independence and privacy, also have some drawbacks. The Optacon, using a tactile method of communication via a special machine, is expensive for the average person (about \$10,000) and is difficult for many people to master. The Optacon is more an aid than a device to provide total reading independence because it takes more time than does braille--and this is a disadvantage for the professional who must read copiously and rapidly.

The Visualtek magnifying machine which blows up print to any desired size is obviously too bulky and slow for personal use.

The Audiotuner, based on the principle of tones representing letters, is also limited in speed and usability for the person desiring to read at home.

There are on the market several personal reading machines: the Visotoner, the Visotactor, and the Cognodictor. All three machines convert print into a combination of distinct audible tones or tactile stimuli which the trained user can interpret as letters. With the Visotoner one can read 15 to 37 words per minute, depending upon the type of print. It takes about 30 to 40 hours of practice before a learner can use it to check typed material. These machines have use for checking personal typing but are not applicable to rapid and convenient personal reading use.

McMartin Industries has developed an instrument which feeds braille on SCA using a matrix printer. This might be a useful adjunct to a total closed-circuit radio system for

specialized purposes--particularly for material that the visually impaired person might want for certain types of reference, such as figures and involved formulae. Normally, a cassette recorder patched or built into the closed-circuit radio receiver can automatically record from the air anything the listener wishes to hear later. This is an application of the FM slow scan.

Probably the most dramatic machine reading development is the Kurzweil Reading Machine. This computer-based device makes it possible to place a printed page in the machine which then scans the page and transmits the image to the electronic control unit which isolates each character form. Through the use of the computer unit, the device generates the proper sequence of speech sounds and transforms them into recognizable English speech at approximately 200 words per minute. The user can control the reading by having the machine repeat a line, go forward or back one or several lines, and vary the reading speed, pitch and volume. The Kurzweil Reading Machine has obvious potential for many blind professionals who must read a large volume of letters, articles, reports, memoranda, etc. However, the expense per unit (about \$50,000) precludes its use as a personal reading tool. It might warrant future purchase if it could be tied into a large closed-circuit radio system and would be used enough to justify the cost. It still could not provide, however, the human dimension and vocal variations found in the voices of human readers.

Future possible adaptations of the Kurzweil machine to a radio reading service may involve a combination with the computer. For example, a listener could dial a phone number and hear the news via the Kurzweil machine tied in with a teletype news wire. Application of principles already used in instructional technology may be a useful supplement.

Mass Distribution and Reading Services for the Blind via Closed-Circuit Radio

For the past seven years a portion of the FM radio signal has been used to transmit the reading of daily newspapers, magazines, books and other information to visually handicapped persons listening on radio receivers tuned to pick up only that particular frequency. It is essentially a closed-circuit system available only to those people who have the pretuned receivers. This use of radio has been variously called "Radio Talking Book," "Radio Reading Service," etc.

The first systematic use of radio to provide a daily reading service for the blind and visually handicapped occurred under the joint auspices of the Minnesota State Service for the Blind and Visually Handicapped and the Minnesota Public Radio stations. In discussing the origin of the service, C. Stanley Potter, Director of the State Service for the Blind and Visually Handicapped, wrote that it was becoming increasingly clear that "... a substantial group of visually and physically atypical

people were becoming socially and vocationally typical people in the society but without the current and local input of the people about them." A number of possibilities for providing that current information were discussed: the use of "ham" radio seemed a possibility, but the problems of frequency allocation and cost could not be solved; and an occasional program on the main channel of AM or FM stations would not provide a flexible enough service.

The answer was found in the subsidiary channels of existing radio stations--Subsidiary Communications Authorization, referred to as SCA. This portion of the FM channel has been used for many years for "Storecasting"--the transmission of background music to stores, dentists' offices and similar commercial users who pay for the service.

Use of SCA has several advantages: (1) it is not necessary for a reading service to secure additional frequencies which are probably unavailable in today's spectrum squeeze; (2) cost is within reason since the expensive transmitters, towers, antennas, etc. are already present at the FM station distributing the SCA signal; and (3) FM signals are stable both day and night and are little affected by ionospheric changes.

Through the happy combination of strong interest by the Hamm Foundation (which provided funding) and Minnesota Public Radio (which operates five full power transmitters, covering the state of Minnesota, which was strongly interested in using their SCA for this purpose), the Minnesota "Radio Talking Book" was created on January 2, 1969. Since that date radio reading services under various names (Radio Information Service, Golden Hours, The Washington Ear, etc.) have been established in Greenville and Charleston, South Carolina; Lawrence and Wichita, Kansas; Portland, Oregon; St. Louis, Missouri; Seattle, Washington; Lancaster, Pennsylvania; Cleveland, Columbus, and Youngstown, Ohio; Memphis, Tennessee; East Lansing, Michigan; Washington, D. C.; and San Diego, California. More are in the planning stage.

The existing radio reading services are operated by a variety of organizations such as (1) state agencies (as in the case of the Minnesota "Radio Talking Book"), (2) private agencies (e.g., the Cleveland Society for the Blind's "Cleveland Radio Reading Service"), (3) independent organizations formed solely for this purpose (e.g., "The Washington Ear, Inc."), (4) public radio stations (e.g., KANU, Lawrence, Kansas), and (5) religious organizations (e.g., the National Shrine of Lady of the Snows, Belleville, Illinois, providing the radio information service for the St. Louis area). Both the American Foundation for the Blind and the Corporation for Public Broadcasting are providing national support and coordination for the development and expansion of radio reading services.

The first national conference on radio reading services was held in March, 1975, in Oklahoma City, and the second

conference met in Minneapolis in May, 1976. Both conferences were sponsored by the American Foundation for the Blind. The Corporation for Public Broadcasting compiled an extensive handbook on forming radio information services for the print handicapped and provides a full-time staff person to assist in the organization, development and funding of local services. (The handbook, "Radio Information Services for the Print Handicapped," is the most comprehensive source of information printed to date concerning establishing and operating radio reading services and should be a major reference.)

The best example of a state network for the blind and visually handicapped is the Minnesota "Radio Talking Book." Program origination for this network is in St. Paul, Minnesota. The same program is transmitted over five powerful FM radio stations covering most of the state. The programming is, of necessity, of state-wide interest. Newspaper reading is primarily from the Minneapolis-St. Paul papers. Other reading includes magazine articles and books. There are very few "rehabilitation" programs and few telephone call-in programs--to be referred to in the remainder of this report as "teletalk" programs. Newspapers from outside the twin cities are represented by an approximately one-half hour reading per day, fed to the station by telephone to be broadcast. Thus, the Duluth or Rochester or Moorhead newspapers would be read perhaps only once per week. The justification for this kind of centralized programming is that the population, business, financial, and cultural center of Minnesota is in Minneapolis-St. Paul.

"The Washington Ear" in Washington, D. C., serves quite different needs. In addition to the reading of the Washington Post and the Star, the Sunday New York Times is read plus many current magazines and books. Discussions and radio plays are also aired. There is very little "rehabilitation" programming. Programming on "The Washington Ear" assumes a relatively high level of education and cultural sophistication on the part of the consumers of the service. "The Washington Ear" is an independent, nonprofit corporation not directly affiliated with any state or federal agency serving the blind.

The Cleveland, Ohio, Radio Reading Service is affiliated with the Cleveland Society for the Blind, a non-governmental multi-purpose agency. The Cleveland service covers the city of Cleveland and suburbs. Its programming consists of reading the Cleveland newspapers, magazines, and a few best-selling books. Many "rehabilitation" talk programs, covering a wide variety of subjects, assume high priority in this service. These programs usually have some listener input via teletalk shows.

In Columbus, Ohio, the Central Ohio Radio Reading Service is an independent agency servicing the blind and visually handicapped within a 50-mile radius of Columbus. The programming out of Columbus, in addition to the reading of local newspapers, covers many aspects of rehabilitation. These programs are almost

entirely produced by the blind consumers themselves and are all teletalk in form. There is a strong element of sharing and self-help in the programming.

The Philadelphia Radio Information Service is an independent agency serving the entire Greater Philadelphia metropolitan area, encompassing four major counties as well as portions of Delaware and New Jersey. Local interest assumes a high priority in this service which thinks of itself as "family radio." Local and neighborhood newspapers and current books and magazines are read. Essential shopping information, interviews, personality shows, travel featurettes, local TV schedules, and job information make up an important part of the programming. Of particular interest is the fact that three of the five technicians are blind, as is the person responsible for evaluating programs and contacting potential and current users of the service. Representatives from approximately 25 area organizations, directly or indirectly involved in services to the blind, make up the agency's advisory board.

Advantages and Disadvantages of Radio Reading Services

There seem to be several advantages of a radio reading service:

1. Unlike braille or the machines previously mentioned, no training is necessary to use the radio reading service. The receivers are simple to operate since they are pretuned to only one signal and they require only one combined on-off/volume control.
2. The service is available to users over a fairly wide geographic area. Distribution is not dependent on mail delivery.
3. Current daily (even hourly) information can be broadcast. There is no lag between the date of publication of the print material and the delivery to the user. Thus, the print handicapped person is on an equal footing with the sighted individual keeping current with his daily newspapers and weekly magazines.
4. Daily contact between the various rehabilitation and service agencies can be maintained at a fraction of the cost of mail or personal contact.
5. On a per user basis, the radio reading service is economical, approximating the cost of a yearly subscription to a daily newspaper.
6. A wide variety and large volume of information can be provided from which the user may select.

The disadvantages of the use of radio as a closed-circuit reading device are:

1. The ability is limited to personalize the service. Letters, for example, cannot be read to individuals.
2. The schedule is relatively inflexible. While attempts are made to shape the schedule of reading to most listener needs, there are, inevitably, some who would find it inconvenient.
3. The choice of program material cannot meet each individual's unique needs and tastes. While efforts are made through continuing evaluation of the program content to determine need, some individuals will not be completely served.
4. The content is evanescent. For most of the program material there is no opportunity to lay it aside and pick it up later for re-reading. However, with advance notice, listeners can tape record material for playback at their leisure. Some programming would be designed with that purpose in mind.

In this discussion we have identified the basic communication and social needs of the visually handicapped and have explored advantages and disadvantages of the various methods and technologies employed to assist them to attain print-reading independence, convenience, and privacy. The following presentation focuses upon the reading needs of the citizens of North Carolina and how they are served. It suggests that such needs may be served better by a radio reading service.

RADIO READING SERVICE FOR NORTH CAROLINA:
A SURVEY

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Population Characteristics

There are some 14,000 identifiable blind persons in North Carolina. There are an unknown number of other citizens who are unable to use print material because of seeing disabilities or physical limitations. The residential distribution of blind and visually handicapped is approximately the same as that of the sighted population, with a five percent variance in the Eastern and Western (Department of Human Resources) Regions. There are about one-half more blind persons per 100,000 population in the Eastern than in the Western Region.

A significant proportion of the blind population (48 percent) in the state is over the age of 65. In the Eastern Region this rises to 50 percent over 65. In the state, 77 percent of the blind population have less than an eighth-grade education, 16 percent have completed nine to 12 years of school, and four percent have more than 13 years of education (three percent unknown). The large majority of blind persons in the state (81 percent) do not live in institutions, but live either alone or with relatives or friends.

There are no statistics at this time on the number of reading devices available to the blind and visually handicapped in the state or the number of people who have the skills to use them. However, it is known that nationally only 10-15 percent of the blind are able to read braille. The age and educational level of the North Carolina population would suggest that probably no more than 15 percent--if that many--are able to read braille. There are also no data on the distribution in this state of large print newspapers (The New York Times) and books. The North Carolina Library for the Blind and Physically Handicapped in the Department of Cultural Resources, cooperating with the Library of Congress Division for the Blind and Physically Disabled, distributes a wide variety of adult and children's books and magazines on disc and tape throughout the state.

Information Needs of the Blind

Blind and visually handicapped citizens have the same information needs as do sighted individuals plus those special requirements determined by their individual physical and psychological condition. Some of these needs for general information about the daily flow of national, state and local

events, changes in life styles and entertainment are met by radio and television broadcasts. Much of the content of television news and information broadcasts is available to the blind via the audio channel. Talking books provide a wide variety of fiction and non-fiction (though not as wide a variety as is available to the sighted). For those who read braille, some books, magazines and personal information media such as letters are available.

What is not accessible to the blind and visually handicapped in North Carolina is that considerable amount of current, detailed and often specialized information printed and distributed only in the daily press. Nowhere else are these broad features available: detailed reports of school board meetings, the city council, etc.; editorials and special columns; women's news (including news of weddings, cooking, housekeeping, marriage and family life, etc.); religious news; detailed sports news; entertainment news and reviews; crossword puzzles; columns on bridge, chess, etc.; weekly grocery advertisements (especially the "specials"); advertised department store sales; notices about meetings of various groups and organizations; farm and agricultural news; the daily and weekly comics; and births and deaths.

The North Carolina Library for the Blind and Physically Handicapped has more than 30 weekly and monthly magazines on disc. The value of most of these periodicals is not damaged by the time lag required to prepare and mail the discs. However, the news magazines are highly current and reader interest diminishes with the passage of time. Popular magazines not available on record provide articles which become the topic of conversation among sighted people and should be available to the blind.

The blind and the visually and physically handicapped have additional information needs. These may be placed under the broad category of "rehabilitation guides for coping in a sighted world" and could include the following:

1. Mobility and Orientation--General information on all aspects of indoor and outdoor mobility orientation; specific information on movement in public buildings (e.g., a taped tour of a department store offering a sale, how to find the county tax office, etc.).
2. Community and Government Resources Available to the Blind and Visually Handicapped--This includes information on such service programs as Medicare, Social Security, vocational rehabilitation, food stamps, family counseling, financial assistance, health services, homemaker services, transportation services, etc.
3. Career Development and Training--Availability of such programs as the business enterprises program (including continuing information for those

individuals operating businesses), development of new careers, availability of training, etc.

4. Recreation and Leisure Activities--Information and ideas on activities and recreation that can be enjoyed by people with various types of handicaps.
5. Living and Coping with Blindness--A sharing of experiences among the blind about living with visual and physical handicaps, and inspiration through interviews with blind people who have succeeded in particular professions and occupations.

Survey of Information Needs of the Blind in North Carolina

In order to ascertain radio, television and other communication habits and preferences of the blind in the state of North Carolina, a survey instrument of 42 questions was administered to a statewide random sample of clients whose names were drawn from the register of the Division of Services for the Blind, located in Raleigh. A total of 160 questionnaires were usable, with findings obtained from 66 male and 95 female respondents. Because some respondents did not, or would not, respond to particular questions, the total number of responses does not always equal the total number of respondents.

On an average day, 65 percent of the respondents listen to radio. Of these, 75 percent listen in the morning, 40 percent in the afternoon and 41 percent in the evening. As can be seen in Table 1, some of these listen all day, or in combinations of day parts, with 13 percent listening all day.

Table 1
Radio Listening Habits of the Blind
Shown in Percentages

Morning	Afternoon	Evening	Day Parts
.13	.13	.13	All day
.37			Morning only
.15	.15		Morning and afternoon
.10		.10	Morning and evening
	.07		Afternoon only
	.05	.05	Afternoon and evening
		.13	Evening only
.75	.40	.41	TOTALS

Table 2
Television Listening Habits of the Blind
Shown in Percentages

Morning	Afternoon	Evening	Day Parts
.05	.05	.05	All day
.09			Morning only
	.12		Afternoon only
		.27	Evening only
.08	.08		Morning and afternoon
	.16	.16	Afternoon and evening
.07		.07	Morning and evening
.29	.41	.55	TOTALS

Of the 84 percent who listen daily to radio, the mode is two hours a day for 29 percent of the listeners. As seen in Table 3, 11 percent listen one hour daily, another 11 percent listen three hours daily, 10 percent four hours per day, 8 percent listen about eight hours per day, and 4 percent an average of 12 hours daily.

Television listenership attracts almost the same number of people, or 138 out of the sample of 160. Of these the mode is again an average of two hours per day. We find that 8 percent listen to TV one hour per day, 24 percent listen two hours, 17 percent three hours, 18 percent four hours, 8 percent five hours, and 7 percent six hours, with a drop until we find 8 percent listen about 12 hours daily.

Table 3

Comparison of the Number of Hours Blind Persons Spend
Listening to Radio and Television

Hours Listen to Radio Daily	Percentage of Listeners	Hours Listen to TV Daily	Percentage of Listeners
1	.11	1	.08
2	.29	2	.24
3	.11	3	.17
4	.10	4	.18
5	.07	5	.08
6	.01	6	.07
7	0	7	.01
8	.08	8	.03
9	.01	9	.01
10	.01	10	0
11	0	11	0
12	.04	12	.08
TOTAL	.84	TOTAL	.86

We must remember that these are from the same respondents so there is the possibility that with a norm of two-hour listenership for each medium, those responding may spend an average of four or more hours daily with electronic public media.

The main distinction appears to be that radio listenership is highest in the morning at 75 percent compared to 29 percent listening to TV, while TV listenership peaks in the evening with 55 percent listenership compared to 41 percent listening to radio. Afternoon use of the two media is almost identical, with 40 percent choosing radio and 41 percent choosing TV.

An important finding is that 84 percent of the blind listeners use radio daily and 86 percent use television regularly--indicating the importance of the electronic media as a source of information and entertainment and also suggesting easy canalization from mass radio to a potential closed-circuit radio service.

Newscasts have high listenership, with 70 percent listening regularly to radio newscasts and 79 percent listening regularly to television newscasts; 48 percent of these listeners consider radio their main source of news, while television is the main source for 36 percent. Only nine percent rely on newspapers as their main source, and six percent use word of mouth. Only one respondent considers magazines a main news source.

Of the 160 respondents, 55 percent enjoy local news, 30 percent like national news, and 17 percent are avid followers of international news. Sports news attracts 17 percent, business news interests 5 percent, fashions are important to 4 percent, editorials to 7 percent, and 2 percent enjoy special features.

Seventy-six percent of the 160 respondents feel they have enough ways to get local and national news, while 68 percent are satisfied with ways they obtain news of international affairs; whereas 21 percent desire more sources of local news, 14 percent seek more sources of national affairs news, and 15 percent desire more access to international news. We must remember that these preferences are not mutually exclusive, because respondents were free to make more than one choice when replying to the question concerning news preferences. But the data do indicate the types of news most likely to be sought by the blind population, and they suggest guidelines for the content of newscasts on a radio reading service.

The data summarizing the respondents' favorite radio and television programs show that 17 percent of the respondents are most interested in news, followed closely by 16 percent each choosing family shows, situation comedies and soap operas as their favorite type of programs. Religious programs and religious music earned first choice of 14 percent of those surveyed, while 10 percent most enjoy musical and variety shows. Nine percent prefer detective and police programs as their favorites, while 5 percent most enjoy talk shows or westerns.

Sports programs interest 3 percent, and the remaining 5 percent of the respondents indicated interest in a miscellaneous assortment of shows including weather, movies, obituaries and "stories."

Other sources of reading information used by the respondents include talking book records, used by 43 percent, and talking book cassettes, used by 21 percent. Of the 160 respondents, 28 percent have cable TV in their homes. Almost all of the 24 percent who have heard of radio reading services for persons with visual impairment got their information from a wide variety of sources such as friends, counselors, and a few from TV.

Table 4 shows in rank order by percentages the types of programs and degrees of interest to future users of a possible radio reading service in North Carolina. Because respondents had a choice of indicating either "interested" or "very interested" and degree of interest was the information sought, a total interest index by percentages was found by adding both levels of interest. Persons seeking further analysis can refer to the table to ascertain slightly different degrees of interest in the various program categories.

The program category of music ranked first with 78 percent indicating interest. It reveals present listening tastes, since music is a staple of radio, and does not reflect an understanding of what a radio information service could be like. News of special interest to the blind and visually impaired ranked second for 76 percent of the respondents, followed closely by 73 percent having interest in reading of newspapers and also call-in programs with topics of interest to the blind and visually impaired. On-the-air reading of newspaper advertisements of local sales and prices received a vote from 67 percent of the subjects, while 64 percent had interest in programs that would teach the blind to do things such as gardening, cooking, etc. Interviews with staff members of local service agencies were considered valuable by 60 percent of the respondents; travel programs using sound descriptions of places tied for seventh rank with radio plays as of interest to 57 percent. Information about current happenings, shows, and special events in the area shared eighth rank with the reading of magazine articles for 54 percent of those researched, while reading from great books and current best sellers tied for ninth rank by 49 percent of the respondents.

A summary of the survey reveals that 78 percent indicated definite interest in listening to a radio reading service, 8 percent would not comment either way, and 14 percent said they were not interested. These findings suggest a high degree of interest in local matters and of involvement by the blind themselves in the program content, as well as a desire for local news from the newspapers.

Table 4
 Ranked Interest Index of 13 Program Categories
 Reported in Percentages

Rank	Program Category	Not Inter- ested	Inter- ested	Very Int.	Total Int.
1	Music	.16	.44	.34	.78
2	News of special interest to blind and visually impaired	.16	.54	.23	.76
3	Reading newspapers	.25	.44	.29	.73
	Call-in programs of inter- est to blind and visually impaired	.19	.53	.19	.73
4	Local prices, sales, ads	.26	.39	.28	.67
5	Teaching blind to do things like gardening, cooking, etc.	.26	.46	.19	.64
6	Interviews with staff members of local service agencies	.31	.47	.13	.60
7	Travel programs using sound descriptions of places	.38	.46	.11	.57
	Radio plays	.36	.46	.11	.57
8	Information about current shows and special area events	.38	.39	.15	.54
	Reading magazine articles	.35	.43	.11	.54
9	Reading from great books of the past	.43	.34	.15	.49
	Reading from current best sellers	.41	.38	.11	.49

Analysis of projected program preferences suggests extremely high interest in programs with content of particular interest to the blind and visually impaired--especially of talk and call-in shows about how to do things as well as information or interviews with specialists in matters concerning this group of potential listeners. Reading of newspapers attained high priority for 73 percent, but reading of books and magazines rated only 49 percent--still a high percentage of the total respondents. It may be that the availability of talking books and the low educational level of many of the respondents would explain the lower interest in books and magazines. It is recommended that any follow-up survey also attempt to record the age and educational level of each respondent so that data may be examined from these perspectives as well.

It seems clear to the investigators that a radio communications service for the blind and visually and physically handicapped in North Carolina would have the potential of bringing considerable numbers of previously excluded citizens into the mainstream of society. A radio reading service could dramatically expand the resources of the blind themselves by expanding the informal blind community which now exists. A radio service could also provide a continuing feedback to the various agencies which would provide an indication of the effectiveness of their service programs. All this can be done for the approximate cost per person of no more than a subscription to a daily newspaper.

OPERATIONAL APPLICATIONS OF TECHNOLOGY

Project VOCAB
North Carolina State University

A DESCRIPTION OF PROJECT VOCAB

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Project VOCAB, or Vocal CAI for the Blind, has been created in response to the needs of blind and visually impaired North Carolinians of the age to benefit from vocational and professional training. Those aspects of Project VOCAB to be discussed include the nature of the job situation for the blind and visually impaired, the project's general objective, equipment, the area to be served, learner training, computer-assisted instruction (CAI), completed project goals, future objectives and evaluation, the project's relationship to the university, and its funding.

The Nature of the Job Situation for the Blind and Visually Impaired

A large number of blind and visually impaired North Carolinians of working age are unemployed, and many with jobs are seriously underemployed. They perform well below their aptitude and ability because they lack the knowledge and skills to reach their maximum capabilities. An analysis of the reasons for this low level of achievement for blind and visually impaired persons discloses one major factor: the instruction they need is inaccessible to them. Critical parts of the available instruction are based predominantly on visual input and visual feedback. The only way the blind or visually impaired can survive these visually oriented portions of the instructional process is through extensive one-to-one tutorials in which the tutor must possess the knowledge and skills of the instructor in the course. However willing instructors may be to help the blind or visually impaired learner, they simply do not have sufficient time to tutor him. They often cannot provide the help and feedback in practice sessions that are required for a blind or visually impaired learner to be able to perform successfully on a par with his sighted counterpart.

The General Project Objective

The general objective of Project VOCAB is to develop a support program for the blind and visually impaired. This program will intersect the instructional process at those points where tutorial and practice assistance is needed by using computer-assisted instruction with voice response (CAI/VR). These self-tutoring and practice procedures will be employed at the community college/technical institute level in conjunction

with regular classroom instruction. By the use of CAI/VR modules, the pupil communicates with the instructional program by means of a typewriter-like keyboard and receives messages from the computer-assisted instructional program by synthesized voice response. Essentially, he types messages to the computer-tutor and the computer-tutor talks back.

Equipment

The three major units of equipment comprising a learner station are "off the shelf"; that is, no electronic equipment has been designed and built just for this project. All equipment has been purchased through an open bidding process with the low bidder supplying the equipment.

The station for this phase of the project is built around the Wang Laboratories, Inc., BASIC 2200 system, the first of three major units of the equipment, which functions as a controller for both station functions and communications to the host computer. As a controller, the Wang system is more than is needed for any single function of the station. In total, however, it allows the project to evaluate a number of possible alternatives both in the larger area of job re-engineering within the data processing industry and in the development of a learner station for rehabilitation training. In the future, learner stations can be configured to meet specific needs, with the cost reduced accordingly. Basically, what is needed as a minimum central unit is any computer terminal that can transmit and receive data to and from a host computer at 30 characters per second.

The second unit of equipment, functionally the most important, is, in fact, the technological achievement that makes the project possible: a VOTRAX Audio Response System, or electronic voice synthesizer. The VOTRAX is manufactured by the Vocal Interface Division of Federal Screw Works, Troy, Michigan. It is this device that converts coded information from either the station controller or host computer into vocalized speech. Electronically the VOTRAX unit recognizes those codes that are to be converted to speech and converts them. Other computer information is passed on to the controlling terminal to be displayed in typical visual fashion. Computer support programs can be constructed so that information displays can be produced both in typical fashion for the sighted and in spoken format for everyone to hear. The spoken vocabulary which these computer support programs can generate is just as unlimited as the vocabulary in printed text.

The third unit of the learner station is an appropriate device for communication with the host computer. Generally, this device is called a modem, or data set, and is used to convert computer-coded information into signals that can be transmitted over voice grade telephone lines. If the learner station is in the proximity of the host computer and can be connected directly, a telecommunications device is not needed.

The Area to Be Served

Through the use of the existing telephone company networks, the entire state of North Carolina can be served. The host computer, a Hewlett-Packard 2000 Series Access System, is resident for all of the support instructional computer programs. The H/P system is supported by the Triangle Universities Computation Center at Research Triangle Park, North Carolina. The communications network ties this computing facility to over 50 universities, community colleges, technical institutes, private institutions, and secondary schools within North Carolina. This network of users is serviced by the North Carolina Educational Computing Service, a Program Division of the University of North Carolina. Expansion of the network can be accomplished via telephone lines or other telecommunications systems and can expand to any regional limits up to the capacity of the host computing facility. Time-share service for program operations of the host computer is purchased on a flat fee, monthly basis.

Learner Training

Briefly mentioned in the "General Project Objective" section was the fact that the learner communicates with the instructional program by typing on the typewriter-like keyboard of the learner station. A vocal response is produced through a voice synthesizer which is fundamentally a phoneme generator. Initially, the learner is taught the key labels on the keyboard with four cassette tape lessons developed by the project and used in a regular tape recorder. For those four lessons, called "General Description: Learner Station Keyboard, Wang 2200," the minicomputer is programmed so that the key the student strikes is vocalized. Using this learner station keyboard program and the four lessons in the tape recorder, the learner can familiarize himself with the four zones of the learner station keyboard and develop the necessary typing skills that are required to communicate with the CAI/VR programs.

Computer-Assisted Instruction

The four cassette tape lessons prepare the learner for computer-assisted instruction, which is built around computer programs that conduct a dialogue between a computer and the learner. The instructional material contained in a lesson is that which has been written by the lesson author to achieve some specific behavior changes within the learner. The dialogue for CAI/VR for this project begins as the learner calls the computer over a telephone; he identifies himself and the lesson he wishes to begin or continue. Having established a linkage to a lesson, the student, through the voice synthesizer, hears the computer "read" a section of information from which the learner is to gain some new knowledge. After the presentation of this information, the learner is asked a question about what he has just learned. All questions at this phase of program development are multiple choice; the learner responds by typing in the number of his

choice. Whatever the learner's response is, the computer immediately transmits to the learner new information based upon his response. This immediate knowledge of results given to the learner is a most important factor in the changing of behavior. At once the learner knows whether or not his response is correct; if so, this newly acquired knowledge is reinforced by the very fact that a learner knows he has just learned something new. If the response is incorrect, the learner becomes aware of this fact and proceeds accordingly.

The CAI/VR programs are so designed that for correct responses, additional information is given to support the answer, and the learner proceeds to the next section in the lesson. If, however, the answer is wrong, more information about the subject matter is presented and the question is asked again. A correct answer will then advance the learner to a new section. An incorrect answer will bring more information and the question again. If, after three tries at a given question, the learner still gives an incorrect answer, the entire section is presented again.

At each step of the learning process, the progress of the learner is monitored by the CAI/VR program. If a learner is having difficulty advancing through a lesson--that is, if there is little or no positive reinforcement for correct work--the program will know of this difficulty and take some action. Alternatives to poor performance include: branching back to early sections of the lesson, where performance was better, and reviewing the material; branching to another lesson for additional information as background to the current lesson; suggesting that certain other materials be reviewed before continuing the lesson; and referring the learner to his proctor for help.

Because the instructional materials are presented in a one-to-one tutorial fashion in which the learner can work in private, he can proceed systematically through materials until each step of the lesson is learned. Each learner can then take the necessary time to acquire the knowledge contained within the CAI/VR support modules.

Completed Project Goals

The specific objectives and progress for the first year of Project VOCAB are in three parts. First, a learner station has been designed to allow the learner to communicate with the instructional materials by means of a keyboard and voice response. A computer program has been designed to be used with the training tapes for keyboard skill development. Second, a production station has been developed for rapid, efficient generation of synthetic speech. Three computer programs have been developed for translating English text into synthetic speech. TRANS, a program used to translate English text into phonetics by letter-to-sound rules, has been modified for use by Project VOCAB. The major developmental work was conducted by the

Naval Research Laboratory, Washington, D. C., and is documented in NRL Report 7048 entitled Automatic Translation of English Text to Phonetics by Means of Letter-to-Sound Rules by Honey Sue Elavitz, Rodney W. Johnson, Astrid McHugh and John E. Short. VPACE, or VOTRAX Phoneme ASCII Code Editor, is a program used to generate or improve individual words that will later be assembled for lesson material. VTEXT, or Vocal Text Assembler, is a program used to assemble vocalized text into lessons for CAI/VR. The third part of the completed project goals is the development of a pilot CAI module. Through this first lesson, standard format for writing the lessons, review processes, and documentation standards for future lessons have been established.

Future Objectives and Evaluation

The first of four specific objectives for Project VOCAB in fiscal year 1977 is the development of 16 tutorials and drill-and-practice modules to supplement the blind or visually impaired learner's vocational training in data processing and accounting. These courses are found to be part of the instructional requirements of about two-thirds of all technical programs offered at community colleges and technical institutes in the North Carolina system. The six instructional modules in data processing are Binary Numbers, Binary Arithmetic, Data Storage, Flow Charting, Programming Languages and Data Structure; the ten in accounting are The Accounting Equation, Types of Accounts, Debits and Credits, The Balance Sheet, Journal and Ledger, Posting, Adjusting and Closing, Trial Balances, The Work Sheet and Financial Statements.

A second 1977 objective is the field-testing of these 16 modules at Pitt Technical Institute in Greenville, North Carolina. This testing will consider the performance of the learner on both the course and the supplementary module. Course achievement will be based on exam scores and teacher/advisor appraisal of the learner. An evaluation of these first two 1977 objectives will include these field-testing results.

The third project objective is to explore the use of CAI/VR in data processing and basic accounting at other community colleges and technical institutes. A fourth objective is to examine the possibilities of persuading businesses to use synthesized speech in their data processing for the purpose of hiring the blind and visually impaired. Evaluation of these two objectives will take into account the amount of success achieved in each venture.

Relationship to the University and Funding

VOCAB is a project of the Office of Research and Extension Services, School of Education, North Carolina State University at Raleigh. The ORES is an administrative unit through which all educational research, development, and extension projects of the School are channeled. It is under the direction of the Dean of the School. Funds are provided on both federal and state levels.

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INSTRUCTIONAL TECHNOLOGY AND THE HANDICAPPED

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Introduction

We have been listening to papers and observing demonstrations which tell us and show us how modern technology can aid the handicapped. A great deal of brilliant and useful work is currently being done to develop devices which facilitate both the mobility and the communications of the blind. And so far, the word "technology" has primarily meant the development of mechanical and electronic hardware. I want to spend some time talking about another kind of "technology" which I believe can be of even more fundamental value in providing facilitative services for the blind. This is "instructional technology." I will talk about instructional technology especially as it pertains to job training for the blind because, from my point of view, job training is one of the primary tasks of rehabilitation.

What is rehabilitation? Instead of looking at formal definitions, let us look at what happens. As the result of some physical deficit, whether congenital or adventitious, someone is not able to perform up to his abilities or to cope fully with life. Rehabilitation is to provide service which will assist the handicapped person to compensate for his deficit. As a result of these services the individual will, at minimum, be able to function as a self-supporting economic unit or, at maximum, be able to function up to the limits of his individual ambition and capacity. Part of this service will be the provision of ancillary support aids, such as the cane or the Optacon. The bulk of this service will necessarily be training, even though it is not usually conceived this way--mobility training, training in self-confidence, training to read braille, and some form of job training.

The minimum goal for rehabilitation will be to enable the individual, despite his deficit, to function as a self-supporting economic unit and to gain personal independence. This is clearly a goal that is not always reached. Sometimes the failure to reach this goal derives from the fact that we define economic independence too narrowly as simply the possession of job skills. For the handicapped, this is not enough for economic independence. To compete successfully in a job requires more than just a set of job skills. Training is also needed in a number of fundamental living skills which may have been severely disrupted or never adequately developed as the result of the deficit. I will refer to these fundamental skills as "adult basic education." These for the blind would include not only mobility skills, which are well taught, but also things like materials management, financial management, communications

skills, computational skills, and social skills. Without a minimum level of training in adult basic education, job training is a waste of time, because an individual without these skills cannot survive in the job market. This minimum in adult education skills, if carefully studied, may well be higher for the blind than for the general population because of communications problems and a slower rate of information processing brought about by the deficit.

For most of us, the minimum goal of rehabilitation is not enough. The blind should not only be enabled to survive; they should be assisted to develop their talents and abilities as far as they can go. Denial of this verges on a denial of equality of opportunity, and there is no good reason why the blind should be generally restricted to the least skilled jobs. But to develop higher-order skills, the blind will need additional aids and especially additional supplementary training. Because of its central reliance on visual modes of instruction, much conventional advanced training is effectively closed to all but the most exceptional blind pupils. A great need exists currently for developing the supplementary, facilitative learning-systems that will give the talented and motivated, but not necessarily exceptional, blind adults reasonable access to higher levels of training.

Everywhere I turn in looking at rehabilitation problems with the handicapped, I encounter the need for special training procedures, what I call learning-systems, whether in specific job training, adult basic education, or advanced training procedures. Without our development and utilization of such learning-systems the blind cannot effectively compete in the world. And instructional technology is a procedure and a methodology for the design and implementation of learning-systems, systems designed to meet specific training needs.

If this is a correct assessment of the basic rehabilitation problem, why are rehabilitation services not primarily oriented toward the development and implementation of learning-systems? There are a number of answers to this question, at least one of which is the structure of funding support for the handicapped, which, I think, dangerously separates rehabilitation and education. In fact, neither can be done without the other. But there is another, more fundamental answer which, because of its importance, I will want to talk about at several places in this paper.

Some of the attitudes frequently expressed throughout the rehabilitation literature can be summed up by the following statement: The goal of the rehabilitation process is to make the handicapped just like anyone else. If we can develop sufficient mobility and communication aids, if we can spend enough time counseling the blind client, we can then turn him loose on the world (and also get him off our rolls) and he will be able to function--go to school, take available job training, compete for jobs--just like anyone else. And here I feel that I must speak

bluntly because of the importance of the point: The handicapped individual is handicapped, and no amount of aids or counseling will remove that handicap. The handicapped individual with appropriate training can in some, but not all, areas produce exactly the same products as anyone else. But not in the same way. The handicapped individual with an appropriate learning-system can learn the same things as anyone else. But not in the same way. We can facilitate the handicapped individual's solutions to life's problems. We cannot remove the handicap and make him just like anyone else.

My reason for emphasizing this point is not to make discouraging noises, but to highlight the fact that training for the handicapped, specifically for the blind and visually impaired, is not the same as training for the sighted and is continually needed through the life and development of the blind. When a blind trainee passes through a job training program designed for the sighted, essentially intolerable demands are placed on that trainee which can be handled and overcome only by the exceptional. Pointing as an example to be emulated to a blind student who is doing graduate work in higher mathematics does not provide comfort to the blind trainee. It only identifies an exceptional person and convinces the trainee of his incompetence. And counseling, whatever it may do, does not convert good people into exceptional people.

For the blind person to cope with any training program, but especially ones which involve much visual material, such as graphs, charts, diagrams, and the like, which are characteristic of most technical training, special training procedures need to be developed, designed for the special needs of the blind student. Until we invest the time and effort in the development of these special learning-systems, the majority of the blind will be confined to low-level tasks. The procedures for developing these learning-systems do not need to be invented; they are at hand, for instructional technology provides detailed procedures for developing such special learning-systems. The bulk of the report to follow will be an outline of the methods and procedures of instructional technology as it pertains to the development of learning-systems for the blind.

What Is the Function of Learning Technology?

Learning technology is the application of a set of design procedures, borrowed from engineering, psychology and education, to problems in the design of learning-systems. It treats instruction as a system, a system primarily made up of the interaction between the pupil and the instructional materials, e.g., textbooks, programmed modules, instructors, laboratory materials, etc. This system may be regarded as having specifiable inputs, e.g., the entering pupil, and as having specifiable outputs, e.g., the trained pupil. The task of the learning technologist is to design the appropriate instructional materials and the structure of the interaction between the pupil

and the materials to produce the trained pupil from the entering pupil.

The designer will place some measure of control over the pupils entering the system by setting entrance requirements. The pupil will be required to possess some identified properties to enter into the instructional interaction. For example, some courses have prerequisites. Most of the control exercised by the designer, however, lies in his design of the instructional materials and his design of the interaction between the pupil and the materials. This control over the interaction is sometimes achieved through the use of special hardware, as in the case of computer-assisted instruction, where the control is effected by a computer system.

The learning technologist is said to be designing a learning-system. A learning-system consists of more than just a set of instructional materials, texts, workbooks, etc. It consists of these materials, together with a specification of the pupils for which the system will work, the design of the interaction between the pupil and the materials, and the design of the delivery system which controls the nature of that interaction (whether or not this is hardware). This learning-system has as its task the transformation of an entering pupil into a trained pupil.

Because of the nature of some current delivery systems, we sometimes have a tendency to become so enraptured of the hardware, the flashing lights on some control consoles, the neat layout of the student station, etc., that we forget that from an instructional point of view, the delivery system, though important, is perhaps the least important part of the instructional design. The same interaction between pupil and instructional materials can often be obtained by quite different delivery systems, many of which may not employ any hardware. What identifies instructional technology is not hardware, but the design rules which generate the controlled interactions between the pupil and the instructional materials, whatever technique is used to manage that.

I do not want to play down the importance of the hardware, but hardware considerations sometimes have a tendency to exercise too much control over the nature of the instructional design, and that is bad design. We can only put into operation designed interactions that we can control, and this kind of control may be restricted by too early selection of the delivery system. For example, all current CAI questioning techniques are really multiple-choice questions, no matter what the proponents of CAI may tell you. This may very well fit perfectly into a particular instructional design, but if it does not and the delivery system has already been determined, the result may well be very bad instructional design.

Let me at this point raise a basic question: Why is it important for us to consider the design of learning-systems in a

conference on technology and rehabilitation? There are two important reasons: (1) Educational technology is an application of the procedures of science and engineering to the job training process. It provides a means for the development of efficient and effective job training programs, based on techniques derived from modern technology. It is clear that a crucial part of rehabilitation is job training--making the handicapped economically independent. It thus fits the general theme of this conference--the impact of technology upon rehabilitation. (2) There is, however, a second and even more compelling point. The skills and techniques of educational technology are needed for the development of special learning-systems throughout the education, instruction, or training of the handicapped. It is people we are dealing with, and people with a disability. These people will continually need both special job aids and special training materials, wherever they go and whatever their talents and skills.

To expect the handicapped to function effectively in the world requires more than one job training program to develop a set of job skills and a couple of gadgets to facilitate mobility or communication. It requires continuing instruction in how to function in a continually changing world and a continually changing job setting. Instruction is never a one-shot affair, unless all we want to do is to lock our client in a box and then throw away the key. The design and implementation of such special instruction, through the design of learning-systems which take into account both the nature of the pupil and his handicap and of the specific goals of his instruction, are the business of educational technology.

The Design of Learning-Systems

The problem of the design of a learning-system can be broken down into a sequence of relatively distinct problems generated by the primary properties of the learning-system. The learning-system is designed to equip the pupil to do something in particular--take a job, take on further training, perform some set of activities. The pupil is to be trained to perform effectively some task or set of tasks. One cannot efficiently design a learning-system without a clear specification of these tasks. This is referred to as "task analysis." From our knowledge of the task, we can identify what it is that the pupil is supposed to be able to do as a result of his training in order to perform well on the task. The identification of the things the pupil is to be able to do is called "analysis of behavioral objectives." Then, to find out what must be done to the pupil to achieve the behavioral objectives, we must find out something about the properties of the pupil entering the instruction--what skills, what personal characteristics, what deficits. This we may call "pupil analysis." Now that we know where we want to go and where we are coming from, we can design the instructional materials and the nature of the interaction between the pupil and the materials. We may call this "instructional design." Then we need to find a way to control appropriately the interaction

between the pupil and the materials. This is the "design of the delivery system." Finally, we need to determine whether the system works or not, and if not, modify it. This last phase is called "evaluation and iteration." The design of a learning-system thus goes through six phases: task analysis, analysis of behavioral objectives, pupil analysis, instructional design, design of delivery system, and evaluation and iteration.

Task Analysis

Instructional design requires that we be able to specify in detail the nature of the output from the instructional process. The pupil is always assumed to be training for some specific task, whether we are talking about training an auto mechanic, a school teacher, or a neurosurgeon. The design of the instruction must be goal-oriented because the goal and its properties enter into the design process. If the knowledge and skills which the pupil is to acquire cannot be precisely defined, the instruction cannot be successfully designed.

The desired outcome of the instruction is usually identified by two kinds of analysis: task analysis and behavioral analysis. Task analysis analyzes the task that the pupil is expected to perform successfully as a result of the instruction. What does an auto mechanic, a teacher, or a neurosurgeon accomplish? Task analysis seeks to identify the component achievements that are the outcome of a skilled performance on a job. For this analysis, it is often necessary to spend some time observing a skilled performance of the task. Job descriptions or even self-descriptions by skilled performers will often leave out critical components of a task or, equally destructively, will often include as essential components that are in fact never required on the job.

A highly skilled analysis of a task will often result in simplifying the requirements for a job. This feature of task analysis is of major importance for the handicapped, such as the blind, because visual components of a job, essential to a sighted performer, may be unimportant or irrelevant to the actual task achievements. A task analysis concentrates upon the achievements which are the components of a job, not upon the behaviors which may be used to bring about those achievements. And a particular achievement may often be reached by many routes.

Behavioral Analysis

Behavioral analysis, following from the information developed in task analysis, seeks to identify what behaviors the pupil will need to be able to execute in order to achieve the requirements of the task. This analysis seeks to identify the specific knowledge and skills that the pupil must master in order to achieve success on the task. These behaviors will, in turn, define and specify the behavioral objectives of the instructional process. These are the behaviors the pupil must possess if the instruction is to make the pupil a skilled performer at the task.

This analysis must, as it often does not, take into account the properties of the performer. The behaviors required of a handicapped person on a job may be quite different from the behaviors required from one who is not handicapped to reach the same achievements.

Note that the behavioral objectives will talk about both knowledge and skill. We ordinarily have a tendency to talk about behavior in too narrow a way, as if it were identical with skill, and then to limit the notion of a skill to what the psychologist calls a perceptual-motor skill--that is, some highly developed hand and sensory coordination like that of a mechanic or an acrobat. Many of the critical skills on a job are perceptual-motor skills, from the mechanic's skill in manipulating parts during a complex assembly to the surgeon's skill with a knife in removing a tumor. But there are many other kinds of skills in a job which are based on knowledge, not manipulation, such as the diagnostic skill of a good mechanic or the linguistic skills of a simultaneous translator or the design skill of a good computer programmer. All of these things, whether perceptual-motor, diagnostic or verbal, whether they involve knowledge or manipulation, are behaviors, things people do. They may do them well or ill, or fail to do them at all. The goal of an instructional process is to provide pupils with training which will enable them to perform these behaviors with skill, and thereby to achieve the successful performance necessary for personal achievement.

Behavioral analysis must carry out a second job to provide adequate behavioral objectives to the instructional process. It must not only identify the behaviors at which the pupil is to become skilled; it must also identify the level of skill necessary for satisfactory performance on the job where the skill is to be employed. This phase of the analysis is sometimes called "mastery analysis." Most behaviors are capable of wide variations in skill level, from very unskilled to highly skilled. What level for each skill is required for satisfactory performance of tasks on a job? Both instructors and employers tend to err here. There is some sense in which we would like all our pupils, all our employees, to possess each behavior at the highest level of skill. But for a specific job, a high level of skill may not be, in fact, necessary. A warehouse clerk who types up an occasional transfer form does not need to type at 200 words a minute. He may only need to hunt and peck. It would not enhance his productivity one jot to increase his typing skills. To demand high-level typing skills here is a waste of resources both for the employee and for the employer. This same point may be made of many of the skills held to be necessary on many jobs. So it becomes necessary for each identified behavior to be able to specify the level of skill required for satisfactory performance following instruction.

Again, it must be emphasized that the behaviors required for achievement on a task are more than just a set of specific job defined skills. These skills rest upon and presuppose a

knowledge and skill foundation which we have called adult basic education. In many task and behavioral analyses, these components are simply assumed and not included as an explicit part of the analysis. If this foundation is not already found in the pupil at a sufficient level--too often the case with blind clients--it must be built into the objectives of the learning-system, or the trainee will not be able either to master the instruction or to perform successfully on the job following training.

Pupil Analysis

Once we have appropriately identified the behavioral objectives of our learning-system, the next thing that must be done is to analyze the pupils who will enter into the instructional system. This may be done in two ways: (1) The easy way, and one frequently followed in practice, is to define the desired pupil properties which simplify instructional design, and then use these as a screening device for determining which pupils will be allowed to undergo training. By the appropriate design of the entry screening device, one can often develop an instructional system that is nearly 100 percent effective. All pupils who enter will emerge with the desired skills at the desired levels. Of course, not many potential pupils will be able to enter. (2) Where the designer's task is to do something for a given population, the task is much harder. The instructional designer must then analyze the given pupil population and seek to identify its characteristics. The relevant pupil characteristics are of two sorts: (a) The behavioral skills possessed by the pupils before training are sometimes called entering behaviors. The difference between the entering behaviors and the behavioral objectives or terminal behaviors defines the magnitude of the instructional task. Again, adult basic education must be the minimal entry level which can be tolerated by any instructional program, unless that adult basic education is built into the learning-system. (b) The personality characteristics of the pupils relevant to instructional design are factors like motivational level, persistence, achievement needs, self-concept, and the like. These will determine how the pupil will interact with the system. Obviously, one can design a quite different instructional system for highly motivated pupils than for poorly motivated pupils. Instruction that will work well for one set of personality characteristics may work poorly for another. These kinds of considerations are of major importance when working with special populations, such as the handicapped, because of the frequent interaction between the handicap and the relevant set of personality factors.

One of the personality characteristics which frequently accompanies a disability is a very low self-concept. This will be especially true of those disabled later in life. Because of the large contrast between what was possible and now is not, there is a tendency to feel that most things are impossible. Achievement expectations may be set too low, and a high

expectation of failure on the part of a pupil may lead to apparently poorly motivated performance, even when the motivation to succeed is high. Such pupils need specially designed instructional materials with a high level of achievement messages built in, so that the pupil gains from the materials a mounting sense of competence rather than a reinforcement of frustration. If the achievement expectations are successfully raised, the nature of the instruction must be changed, or it will become unsuccessful by over-reacting to what the pupil now has come to consider trivial behavior.

The most obvious fact about pupils is that they differ. Their differences in skills, abilities, motives, and the like will make them interact with a common set of instructional materials quite differently. Instruction that works splendidly for one pupil or one set of pupils may be a catastrophic failure for another. A critical example of this will occur in developing instruction for the blind. Optimal instructional procedures will differ, depending upon whether you are instructing the congenitally blind, the adventitiously blind, or the visually impaired. This difference is not one of either intelligence or motivation, but in the ability to handle and utilize concepts built upon visual imagery. Sentences will be interpreted differently, metaphors will work or fail to work because the meanings of terms will have necessarily been built differently, since they are based on different experience.

Given the diversity among pupils, the instructional designer at this point has several choices open. Sometimes, simply due to necessity, he will adopt the cheapest route and design for the modal pupil in the population. Sometimes the population will be divided on the basis of some critical characteristics, and a different instructional system will be designed for each subgroup. Both of these routines will have obvious weaknesses. Assuming that the instruction is well designed, the instruction will work splendidly for the modal pupils, but not very well for anyone else. An optimum solution is to develop some form of individualized instruction. What this means is that an instructional system is designed such that the instructional process routes the pupil through a pathway of possible instructional materials, a pathway which is determined by the pupil's characteristics as evaluated by his performance on the system. The system and the pupil interact so that optimal instruction is delivered for each pupil, depending upon his characteristics. In the management of this kind of an instructional system it is usually necessary, if any large number of pupils are to be instructed, to develop a system of computer control. Such an instructional system is obviously more expensive, not only because of the multiple instructional materials that must be developed to allow for alternative tracks, but also because of the computer control necessary to manage it. Whether such costs are significant is largely a function of how important it is to us to reach each pupil.

Instructional Design

The next stage in the design of an instructional system is the development of the instructional material. Our analyses to this point have provided us with the behavioral objectives (the output of the system) and the pupil characteristics (the input of the system). Now we must generate that system which will produce that output from that input. This process involves the usual problems about course materials that are common to any instructional process. These problems are somewhat more readily solvable than usual, simply because of the precise specification of the input and output properties. It is also, as usual, necessary to make decisions about the format of the materials; for example, whether lecture or film, whether programmed instruction or problem-solving, about the amount and nature of feedback the pupil is to receive, about whether the pupil's practice is to be under the supervision of the instructional system or done independently, whether the instruction is to be concrete or abstract, and the like. These kinds of decisions will all be made in light of the analyses of the pupil properties and the desired output behaviors. For some of these decisions we have useful criteria. For others, the decisions must be made as the best estimate of the designer and validated or not by the effectiveness of the instruction. The basic grounds for all such decisions are the properties of the pupils and the goals of the instruction. If either of these is not precisely defined, the instructional design can only be haphazard at best. The basic test for the correctness of our decisions is not instructional theory, but whether or not the learning-system, when once designed, works.

Design of Delivery System

The instructional materials that have been developed specify a sequence of interactions between the pupil and the materials. The next problem that must be resolved is that of delivering these instructional materials. How do we structure the instructional situation so that the pupil interacts with the materials just as planned by the instructional designer? How do we determine that the pupil encounters the materials in the proper order so that he does not develop misunderstandings? How do we determine that the pupil gets the right feedback for his effort at the right time? How do we tell how the pupil is faring in interacting with the material? How do we tell whether the pupil should repeat part of the material? How do we determine which materials the pupil will interact with next? It is these questions that are to be determined by the design of a delivery system for the instructional materials.

Within the limits of the demands of the instructional materials, the primary criterion for selecting a delivery system is cost-effectiveness. How much does it cost per pupil to transform the entering behaviors of the pupil into the terminal behaviors defined by the objectives of the instruction? I will not spend much time on this point because of its enormous

complexity. How do you evaluate two systems, one of which processes half of its pupils to achieve the objectives, against another costing ten times as much but processing 90 percent of its pupils to the desired objectives. These are not simple decisions, although they have conventionally been treated as simple. If many of the conventional decisions are examined closely, they are like adding apples and oranges to find out how many bananas we have. We need to talk not just about costs, but about cost-benefit analysis, and benefits are hard to quantify. The only thing I want to say here is that obviously a system that we cannot afford is too expensive, no matter what it will do for us, but the concept of what we can afford, especially when it concerns human life, is itself not a simple one.

The delivery system may take many possible forms, ranging from a book to an instructor in a classroom to a computer-driven instructional system like CAI. The costs of such delivery systems vary enormously. So does their effectiveness in attaining the desired instructional objectives.

Evaluation and Iteration

The final phase in the design of an instructional system is testing and evaluation. In one sense, this is the most important phase, because without it we have little or nothing. We currently simply do not know enough about the instructional process to design a learning-system and know, in advance of testing, just how it will work. I suspect that we will never know that much. The set of interacting factors in an instructional system is just too large to allow us to make absolute predictions or to build models simple enough to use. We find out what we have built by trying it out and seeing how it works. Any time we try, some of what we will see are places where the instruction does not work. It will then require revision, and then again further testing. Most learning-systems will take a number of such iterations before the designers can say with any confidence that they meet their design criteria. And with the final iteration, we will have completed the design process for this learning-system.

The Relevance of Instructional Technology to Rehabilitation: An Iteration

Now that we have been through an outline of the procedures which make up instructional technology, let me again raise the question of relevance: What has instructional technology to do with the handicapped? Much of the answer has already been pointed up in the discussion so far, but I would like to restate and re-emphasize some points.

The blind cannot cope with standard instructional procedures when such instruction is based upon visual imagery. Solving this problem is not just a matter of developing a few special aids, such as raised figures for tactile exploration. Tactile imagery cannot be substituted for visual imagery, for

they do different jobs. Tactile imagery is basically sequential. One feels along an edge. Visual imagery is basically simultaneous. One sees a form. The two senses cannot, by their structure, carry the same kind of information. The tactile sense cannot communicate the same kinds of information as the visual sense, and trying to make it do so will probably lead to misunderstanding of the materials. This does not mean that the blind are locked out of certain kinds of ideas, but rather that the instruction must be totally transformed into a mode that the blind can perceive. Information will have to be summarized in a different kind of way. This requires the development of special instructional materials presented in a special way, i.e., the design of a special learning-system based on pupil characteristics.

A closely related problem stems from the fact that it is difficult and awkward for the blind to scan for information. The physical nature of the scanning process requires that it be sequential, and that is relatively slow. It is thus much harder to look things up. In practice this places enormously greater demands on the memory of the blind pupils than on their sighted counterparts during the learning process. In practice this means that instructional materials must be developed in which much greater care is taken than is usual in designing the sequential properties of the instruction. The instruction cannot carelessly say, "Take note of this now; we will use it later." Such information for the blind will tend to get lost.

For many reasons, a higher than normal percentage of blind persons seeking training will be older than their sighted counterparts. There are special problems in the training of adults not encountered in dealing with younger trainees. The older person has a higher sense of relevance than a younger one, partly simply because he has much more highly formed personal goals. He knows what he wants and has little patience with what seems irrelevant to him. He may be very highly motivated to reach his goals, but he may be perceived by his instructor in the conventional classroom as poorly motivated because he does not take seriously what the instructor takes seriously.

Many of the blind suffer from educational deficiencies of varying degrees of seriousness. Because of the deficiency in vision, the pupil will have missed out at one or another point in instructional sequences. Having missed out, all kinds of later materials will have been missed or misunderstood, often without a clear knowledge of what is wrong on the part of either teacher or pupil. In any advanced training situation, that pupil will exhibit "holes" in his background, often connected with basic education, which will enhance his probability of failure both in training and on the job.

The point of bringing up all of these problems is not to bewail the fate of the blind, but to point up that all of these problems are solvable, not by the development of a massive special education project or the formation of special schools,

but by the development of specific sets of learning-systems designed to compensate for the specific training deficiencies detected by our analyses and field experience. These learning-systems or instructional modules would function as adjuncts to the standard extant training processes, whether in formal education or job training, to add the supplementary training, specially designed for the specific pupil, to correct specific problems.

Instructional technology can be used in rehabilitation to correct for the specific problems encountered in the education and training of the blind to enable them to achieve the goal of rehabilitation--an independent and valuable life. To do this takes more than gadgets, more than clever hardware. It takes peopleware, specially designed learning-systems.

DECISION CRITERIA IN JOB AND JOB STATION RE-ENGINEERING FOR PLACEMENT OF THE BLIND

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Various aspects of jobs for the handicapped, including the background of rehabilitation, job selection, job re-engineering, and hiring organization, and the counselor's role, will be considered in this paper.

Background

Historically, the major contributions to rehabilitation have come from the medical, psychological, and social disciplines; more recently, because of changing patterns and new emphases, a re-engineering approach has begun to emerge, providing the technical means to close the gap between the theory and the actual implementation of job modifications. The terms variously applied to this approach are "job re-engineering" and "job modification," the latter perhaps being the more relevant. The implication in the term "job re-engineering" that some previous engineering has been done is not true in all job situations.

Efforts are being made to add the technical professions to the other professions traditionally involved in this important task. In the past the approach to rehabilitation has been to match the abilities of the handicapped person to the skill requirements of a job and train him to do the task. Most equipment and procedures have been fixed; workers have had to be "designed" or trained to operate the equipment. In fact, this approach is still, to a large extent, normal procedure in job selection for the disabled and the nondisabled. Most jobs are designed with little thought for the human beings who will fill them; the burden is placed on the individual who is expected to adapt to the job situation.

During World War II, with the development of machines that persons could not work, it was necessary to begin to give serious thought to altering the physical world to the abilities of the human being. For instance, some airplanes became too complex to control. As human abilities began to be reconsidered and the machinery altered accordingly, human engineering and, later, human factors psychology began to emerge. Later the space program began to contain the most human-factored machinery ever developed because of the demanding human performance required for the job. Presently there are still only a few areas besides the military to which this kind of person-centered approach has been applied, in which one determines what a person can do and designs the physical environment to complement his abilities. The

individual abilities of both the handicapped and the general worker must be considered in the design of a job station or task that will be satisfying to him.

Job stations are extensions of physical capabilities designed to allow the worker to reach higher levels of achievement. The hatchet and the hammer, as well as the wrench, are physical extensions of the arms, allowing one to split wood, drive nails, tighten bolts, and accomplish other tasks the arms could not have done alone. More complex physical extensions of the body are the mobility extensions--the bike, the car, the plane--which allow one to cover distances impossible to cover otherwise.

A second category of extension, which is more relevant to the re-engineering task at hand, includes the extensions of sensory abilities, like the telescope and the microscope, which extend vision beyond the range of the unaided eye. Even though the astronomer or the microbiologist may have normal 20/20 vision, he needs the appropriate instrumentation to extend his sensory capability for his particular job. It follows that the individual with impaired vision needs that sight extended with a suitable instrument. The world would need to be designed much differently if the norm or benchmark for visual acuity were 20/200 rather than 20/20; even more drastic changes in modes of instrumentation would be needed if the norm were total blindness.

In addition to tools and instruments, there is a third category of extension which is relatively new in terms of job history. The computer, or symbolic processor, is an invaluable human extension, not only in number manipulations, but also in word processing; the use of computer logic for these tasks is evident in an emerging word processing industry, as exemplified in the overhaul of the secretarial trades. The electronic logic processor is actually an extension of mental capabilities. In the task of altering the job world, tools, instruments, and processors must be considered as extensions to accomplish the given task. The solutions to the problems of overcoming particular physical, mental, or sensory disabilities demand a willingness to shift the norm as accepted by the typical job structure, re-anchor the benchmark to varying individual abilities, and restructure the job world accordingly.

Job Selection

If such a re-ordering is the goal, one of the first major considerations is job selection; that is, choosing the kinds of jobs to be restructured, modified, and re-engineered. Two points should be obvious: every job cannot be suitably modified for every handicapped client; and every job that is technically feasible to modify cannot be practical. It must be emphasized, however, that some jobs can be modified for most handicapped persons. It is necessary to consider both the investment and training necessary in job re-engineering. The counselor must be the advocate for his client in identifying the benchmark for

performance, as restructuring must begin with the handicapped person and extend to the job itself.

Our economy is organized into four broad job categories: primary industry, secondary industry, services concerned with the primary and secondary industry, and services for human needs. Historically, the differentiation of labor for all society began with the primary industries--agriculture, mining, forestry, trapping--those occupations which take resources from the earth for utilization. These industries have been declining, rather than expanding, in terms of manpower demands, with about seven percent of the total work force in agriculture; an even smaller percentage work in the other areas of primary industry. With the birth of the Industrial Revolution, secondary industries became the prime employers; for a time a majority of the work force was in some area of manufacturing and production. Today only about 25 percent of the work force is involved in manufacturing in this country; these, too, are declining industries because of automation and imports.

There are two other areas in the labor force that appear to be critical in terms of the future direction of available jobs: service industries concerned mainly with supporting primary and secondary industry and services for human needs. The service industries are the most likely candidates for future jobs. These jobs will provide human services such as medical delivery, social services, government, recreation, and maintenance and support services to the primary and secondary industries and have nothing to do directly with jobs in manufacturing or agriculture. There is a new job market in these expanding service areas which will continue to grow if automation continues to replace people in manufacturing and society continues to demand more human services.

Other considerations are longevity for the client and the life expectancy of the job that is developed. It is psychologically defeating to approach a job with high expectations and have the job become obsolete within a short period of time. Jobs must be modified which provide the individual a career with growth potential; the job that lacks growth possibilities is actually a dead end, not a job opportunity. If one is expected to become a career employee, opportunity must be available to advance his career to higher levels of skill performance and/or management tasks.

Changing trends in job structuring demand heightened concern about placing people in jobs relevant to their needs and abilities. In the past, individuals trained for a menial assembly task were able to find gainful employment; now automation and new procedures in assembly are taking over many of these jobs. The need for greater job satisfaction in some areas of the automobile industry has demanded some reversal of the automation trend by moving from the assembly line to teams assembling a total unit. One lawn mower manufacturer allows one individual to do an entire assembly. The fact is that worker

boredom is reduced when the employer moves his employees from the assembly line to the total assembly position. This concept of assembly removes many of the single-operation assembly tasks that traditionally were filled with disabled workers.

The following job dimensions or characteristics should be present in the job for the individual: a test of his abilities, some control or responsibility within his job, and feedback on his work results. The individual who assembles the lawn mower should have enough to do to challenge him, some definite control over what he is doing, and personal responsibility for any praise or complaints that feed back from his work results.

In the process of job selection for re-engineering it would be helpful to consult the U. S. Department of Labor Dictionary of Occupational Titles to identify groups of jobs which might be modified for a client. In this manner training and re-engineering cost could be amortized over a larger family of job classifications, and within a group the individual could find greater mobility of job opportunities.

Job Re-Engineering

We have the technology to complete very sophisticated mechanical and electronic projects. For instance, spin-off from the space program has produced some very exotic results such as a skeleton-like frame that can control an individual and can actually walk like a robot. The question is with the practicality, cost effectiveness, and utility of the use of technology in job re-engineering. Should such a device as noted above be used in the orthopedic field to help someone walk, or should a task be so re-engineered that the end result is almost total automation with nothing left except the presence of a human observer?

With regard to job modification, it is essential to leave some usage of the skill and energy of the worker in the task. Job satisfaction is at issue here; the handicapped person has the same psychological needs in terms of job expectations and avoidance of boredom as anyone else. In re-engineering, if the task left in the job for a particular individual is menial enough to be totally unsatisfying, then it should be automated.

In our economy we have to be concerned with productivity and the generating of revenue. Therefore, in selecting a job with low production potential, we need to look for jobs with low modification expense for which people can be trained in the short run. For instance, some job shops have not been automated because individuals can be trained to do the tasks much cheaper than it would cost to automate--that is, training and labor costs versus automation costs. Likewise, if there is going to be a larger investment in training and equipment, the job potential must be much greater.

From a practical viewpoint, job re-engineering cost must stand the test, not only of social utility in terms of providing a job, but also of competition with total automation. Automation costs have to compete with labor and training costs; re-engineering cost, likewise, has to compete with alternatives, but be granted a cost handicap as a function of social utility that is measured in terms of worthiness of human involvement.

If jobs are designed to minimize the use of the human being's inherent weaknesses or limitations and to maximize his capabilities, both his efficiency and level of job satisfaction will increase. In order to minimize the weakness, the degree of the limitation must be determined. It is much easier to measure the degree of visual disability than that of physical or mental disability. By the same token, it is somewhat easier to design jobs for the sight-impaired than for the physically or mentally impaired. Technical decisions have to be made on whether total or partial alternatives to visual output are needed. Characteristics of the visually impaired have to be taken into consideration: slowness of movement, lack of visual feedback, slower reaction time, and other aspects. It is essential to create an alternative job environment to fit the limits of the individual where the limits in most cases are relative to that of the sighted worker. Job analysis is the key to job selection and job design; job redesign or modification uses technology to bring the requirements of the job within the range of the physical, mental and sensory capabilities of all workers and differs in degree only for the handicapped worker.

Given the concept that all job stations are designed as extensions of the human operator in order to achieve the desired end, it follows that the extension of the visually impaired worker to achieve the same end involves determining the needed functional extension and re-engineering the job station accordingly. In human engineering terms, this process is a function of the relative benchmarks for human performance. In this regard technology is being used to bring the requirements of the job within the physical, sensory, and mental capability of the individual worker.

The Hiring Organization

The successful employment of handicapped individuals is much more than just selecting a worthwhile job and applying the necessary technology to allow it to be filled by the disabled person. The hiring organization must be in tune with the purpose of job redesign, with reasonable expectations of the level of skills and energy of the handicapped person and with organizational activities which meet the needs and goals of both parties. The company must be willing to allow job modification but should not allow a job station to be modified beyond use or taken over by a non-handicapped worker. Employers must expect of their handicapped workers an economically feasible performance rate, a long-term allegiance to the company, and daily attendance record requirements equal to those of the non-handicapped

workers. Further, the hiring organization, in the creation of a good job environment, must be aware of the need for nearby housing and transportation for the worker and removal of architectural barriers as outlined in federal and state building code requirements. Some manufacturing organizations have begun to design their plants for large percentages of handicapped workers and actively seek to hire and train a mixed population of employees. Another major concern of the employee, the employer, and the counselor should be the need for built-in safety factors outlined in the Occupational Safety and Health Act. It is a public relations matter to convince management of the fact that jobs can be designed for safety to avoid accidents and that the handicapped worker is of no greater risk of accidents than anyone else.

The Role of the Counselor

The essential role of the human service counselor in job modification is presently both massive and demanding. He is expected to be both an educator and a public relations person for clients, employer, and employee. He is expected to locate and point out job possibilities, encouraging the employer to take advantage of those opportunities. He must educate the hiring organization about job safety, having totally familiarized himself with applicable insurance regulations, safety laws, and acts. He must follow up on clients after job placement, making sure that bargains are being kept on both sides. He is expected to keep himself up to date on the available job groupings or "families," as well as the available related services for the handicapped which could help his clients if necessary. He must try to instill in the employee a positive attitude toward entering the labor market and toward accepting the responsibilities of a job position. Finally, he is expected to supply the good public relations and mutual understanding among the members of the community, the employer, and the employee that large amounts of technology and monetary investment cannot alone provide.

Obviously, it is becoming impossible to expect a single counselor to carry such a tremendous load of responsibility; therefore, there needs to be some re-ordering of the counseling situation. One solution would be to employ both counselors and job placement specialists in human services for the handicapped. The counselor's role would be to evaluate the individual in terms of his needs, interests, and aptitudes. This evaluation would then be turned over to the job placement specialist who would match the individual with the available jobs and handle those matters related to the employer. There would need to be ample, frequent communication among the employee, the counselor, the job placement specialist, and the employer, all seeking goals of good public relations and mutual understanding.

OPERATIONAL APPLICATIONS OF TECHNOLOGY

The National Institute for Rehabilitation Engineering

THE NATIONAL INSTITUTE FOR REHABILITATION
ENGINEERING

97 Decker Road
Butler, New Jersey 07405
(201) 838-2500

. . . a non-profit clinical research facility
serving the permanently handicapped

Unique Services in our VISION DEPARTMENT (partial, not all-inclusive summary):

1. NIGHT VISION AID for RP patients and others unable to see adequately in dim light.

These miniaturized electronic devices are available for \$995 for a hand-held unit and \$1,195 for a hands-free unit worn on the head. These aids function even in total darkness, giving the handicapped person better vision in darkness than "normal" people. Special accessories compensate for poor visual acuity, or tunnel vision. Available only with examination, fittings and trials at NIRE - by appointment.

2. FIELD-EXPANDER GLASSES for people with tunnel vision.

Custom-made with patient's prescription only, at this institute. Expands vision from as little as 2 degrees to as much as 180 degrees for walking, driving and other activities. Available for users in these acuity ranges: 20/20 to 20/50; 20/50 to 20/100; and 20/100 to 20/600.

3. CROS-VISION GLASSES for hemianopes and monocular people.

Gives full-field, high-acuity vision on the blind side by detecting images on the blind side and conveying them to the brain via optic pathways on the sighted side in a way which does not cause double vision or confusion. Size/distance ratios are "normal" - even on the blind side.

4. IMAGE-ENLARGING GLASSES FOR NEAR AND FAR for all people having poor visual acuity.

Many different types to help almost all partially sighted people. Some are telescopic glasses; others look to others like ordinary glasses. Must be selected for each user on an individual basis only, at NIRE and by appointment.

5. MACULAR DEGENERATION GLASSES.

Special design projecting enlarged images over the greater part of the retina, and not on a small area where the central scotoma is, as do ordinary telescopes. These special telescopic glasses will improve vision for patients having large central scotomas from: 20/200 to 20/25; 20/400 to 20/50; and 20/800 to 20/100.

6. MULTI-PURPOSE CATARACT GLASSES for people having normal acuity after surgery.

Normal-looking glasses with single-vision lenses, these enable elderly to see the floor and avoid falls, common to the use of bifocals. These glasses focus instantly at any distance from reading distance to infinity, and in between. Users need no other glasses and can see clearly--books, closet interiors, stove, oven interior, TV, and distant objects such as the stage in a theater, etc.

7. LOW-VISION CATARACT GLASSES WHICH MAGNIFY UP TO 3 TIMES for improved visual acuity for low-vision aphakics.

Similar multi-purpose, variable-focus features as above. Lenses are thinner and lighter than ordinary cataract glasses for the same user. Glasses look like ordinary glasses to others and can be quite stylish.

8. FIELD-EXPANDING MULTI-PURPOSE CATARACT GLASSES for aphakics with features listed above, except that a field-expander is added to provide full-field vision to patients who have tunnel vision, who see with only one eye, or who have other visual field problems, including hemianopsia. Variable focus feature is retained.

9. VISUAL SKILLS DRIVER TRAINING.

Specially equipped dual-control cars for people with poor visual acuity, for people with field-of-vision defects, and for totally deaf people who must maintain first-rate visual skills. We assist clients to get permits, licenses, etc.

10. LIGHT-CONTROLLING GLASSES AND CONTACT LENSES for light-sensitive people who may or may not have other visual handicaps.

Especially helpful to albinos, aphakics, and people with aniridia, achromatopsia, etc. A night-driving aid is available to prevent glare from oncoming headlights without reducing the user's view of the road in his own headlights. Low in cost (\$10.95 each), these eyeglass clip-ons must be custom-fitted and cannot be sold by mail. Recommended for non-handicapped also.

11. HEARING EXTENDERS for totally blind and partially sighted.

Fit in the ear canal as one-piece units with no tubes or wires. They extend both frequency range and loudness while minimizing background noises with special built-in filters. They use the natural outer ears as sound collectors, in the normal way, giving enhanced ability to determine from which direction specific sounds are arriving. Also, when both ears are fitted, the user can generally pick out, listen to and understand a single voice when there is background noise or in the presence of other competing voices, as in a crowd. Two types are available: one for people having normal hearing and the other for people having impaired hearing. Both must be custom-made, both physically and electronically, so they cannot be sold by mail, only by visiting the NIRE by appointment.

12. COMPREHENSIVE EXAMINATION, EVALUATION, FITTING AND TRAINING SERVICES for all visually impaired, and for visually impaired who have other handicaps also.

NIRE does not "treat" or "cure" any disability or disease. All persons coming to NIRE are advised to continue under the care of their local (eye) doctors. Even after having been here, NIRE is for people who cannot have their disabilities removed medically or surgically and who can benefit by obtaining technical aids and training enabling them to use what remaining vision they have more efficiently. NIRE's aids neither improve nor worsen any disease or disability.

NIRE does not "sell" equipment by mail. Most of the aids provided by NIRE are of such a nature that they must be custom-designed and fitted, or they must be unique for each patient. That is why patients must come to NIRE by previously arranged appointment. Furthermore, NIRE does not sell any aid to a patient unless it has been established first, through trials with special trial sets, that the patient can use, will benefit from having, and wants to obtain a particular aid.

While NIRE does employ competent and licensed optometrists and opticians to do work which requires their services, the Institute is basically a "Human Factors Engineering" facility--an organization of efficiency experts who are goal-oriented and able to find ways for a particular handicapped person to be able to perform specific tasks which he wants to perform, despite his handicap, using whatever tools, aids and training may be necessary. NIRE SELLS RESULTS--NOT STAFF TIME AND NOT EQUIPMENT.

13. CONCURRENT HANDICAPPING CONDITIONS.

This Institute has departments for helping people with any or all of these problems: speech; hearing; mobility for cerebral palsied and the paralyzed (including quadriplegics); retardation and learning disability; deafness; etc. Our various departments are coordinated so that we are very effective in helping people who have multiple disabilities.

14. COSTS, FEES AND PAYMENTS.

This Institute is non-profit. Many patients' fees are paid by third-party payers. When this is not possible, an applicant completes a short form, and afterward he is charged by the hour for evaluation and training services, at an hourly rate set on a sliding scale, based on his income and means. Equipment costs vary, also based on the patient's income and means. The time required for a service is always estimated in advance as "not less than ___ hours and not more than ___ hours, at a stated rate per hour."

TECHNOLOGY AND TELECOMMUNICATIONS: CONSUMER/CLIENT
ADVOCACY AND ACCESS

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The recent history of social action and human service programs has been reflective of significantly different means for assuring that the voices of consumers and clients will be heard. Such assurance was first observed during the 1950's with the initiation of the civil rights struggle in America. Traditionally and historically, the recipient of services and the bearers of civil rights and human rights simply accepted that which was given them and essentially permitted others in society to articulate their needs and desires. In most instances, these expressions of "what consumers need" were made without the consultation and involvement of the recipients themselves. To state it candidly, the individual who "spoke for the consumers" said, in almost every case, what was politically expedient and professionally accommodating. They defined issues and stated the problems; they contrived the answers and invented the solutions. The programs, activities, and services in this great nation of ours which were supposedly designed in response to the needs of the handicapped were truthfully the need-perceptions of the non-handicapped.

The crucial progress gained by the prominent social activists during the 1950's and 1960's had impetus for persons and programs not directly involved in the campaign for human rights. Rehabilitation agencies, perhaps more than any other public agencies, were guilty of compounded denials of self-determination by consumers. Not only did agencies openly practice "the Santa Claus" syndrome with regard to the provision of rehabilitation service to the handicapped, but many of the rehabilitation agencies relegated ethnic minorities to the lowest conceivable quality of service delivery by reinforcement of the discriminatory values of the dominant society. In effect, black people, Indian people, and female people were the victims of inaccessibility inequality in the opportunity to realize and attain their maximum potential, not only because of their handicaps, but also because of their race and sex. So it is no wonder the civil rights struggle of the 1960's was appealing, in the final analysis, as an appropriate and proper strategy to employ for consumers and recipients of human services.

Dr. Martin Luther King, Jr., set the tone with his famous battle cries of "we shall overcome" and "I have a dream." The rhetorical catalysts served as stimuli to implement changes in attitude and changes in the greater society. They marched and chanted and as they did so they also realized the value and power of their direct involvement in the political processes. The civil rights movement was more than an effort to achieve human

dignity; it was also a struggle for power in which human beings had a role in their self-determination and independence. It was an effort to share in the good things of the American society including education, housing, health and jobs. The foundations for consumer involvement were firmly in place; a different kind of "silent majority" had come to life.

The formulators and authors of the Rehabilitation Act of 1973 (Public Law 93-112) can no doubt take pride in the most relevant and practical legal document the U. S. Congress had produced in many years. The practical nature of the law relates more to the fact that consumers and clients of rehabilitation services played a major role in the development of the legislation, not that the act functions, logistically, in a superior fashion to earlier federal statutes.

There are a number of important features of the Rehabilitation Act of 1973 which were developed as a direct result of consumer involvement in the oversight hearings. Perhaps the most significant of these features is the mandate to serve the most severely handicapped. This notion has resulted in managers and administrators of services to the handicapped taking a new and different assessment of "what is required" to serve this new clientele effectively. These agency aspects are concerned first with the organization, administration, and service delivery system of agencies which are designed, and legally established, to provide rehabilitation and other kinds of assistance to the blind and visually impaired in particular and the severely handicapped in general.

The Service Delivery System

For our purposes in this historic conference, the service delivery system is inclusive of the means and methods as well as the outcomes and results of a legally based organization of opportunities, services, resources, and self-reliance attainment for a specific population in a defined geographical area. These management vehicles have followed the traditional models of organization and administration and are very much reflective of the political demands of the non-handicapped in positions of authority. In many instances, efforts have been made to "industrialize" these human service-based organizations with an eye toward efficiencies in management rather than effectiveness in the full growth and development of the individual as an independent and interacting human being. The industrial model emphasizes the needs of management by advocating and indeed demanding wholesome administration and performance on all levels of the organization to achieve profits in the sale of goods and services. As the profit motive becomes increasingly important, concern and consideration for the consumer tend to diminish as evidenced by the numerous edicts and sentiments between the various federal agencies such as the Federal Trade Commission, the Food and Drug Administration, and other public interest groups and producers in the private domain of the American economy. It follows, then, that social agencies in an effort to

be "efficient" portray symptoms closely resembling the principles, values, and practices of the industrial model. The intention here is not to suggest anything less than effectiveness or the efficient management or administration of service delivery to individuals with handicapping conditions to employment. I am suggesting, for your serious consideration here today, that efficiency within a vacuumized context and absent of any regard to the self-actualization aspirations of human beings with handicaps to employment--who are first and foremost members of the human race--can and will only culminate and result in an unresponsive, unrealistic and, for all intents and purposes, unsuccessful organization of bureaucrats and floundering technocrats who call themselves social workers, counselors, and human service workers. The service delivery vehicle for rehabilitation agencies must not be caught up in the cry for management and more management rather than management for the advocacy of the blind and visually impaired.

As for any organization, agencies and social institutions must be organized and developed around a mission and purpose. Elementary principles of organizational development dictate that form follows function. Essentially, the consumers, customers, and clients of the organization are prominent insofar as a composition of traits, values, attitudes, needs, wants, and interests is concerned. These characteristics are especially significant in relationship to the common perception of the organization's mission rather than the individuality of its consumership with regard to a uniform trait profile. The organizational vehicle is a collective whole and the primary means by which the people, its consumers, pursue their needs.

Interestingly enough, however, the needs to which I just referred are in most instances defined, described, and supported by law or, as a minimum, by administrative regulations or program guidelines. The same is true with respect to the definition of the particular population or target group faced with the need. Further, it is also true that the necessary resources to provide for the resolution of the problem and the meeting of the need are based on statutes or administrative regulations.

The organization of opportunities, services, resources, and self-actualization-directed outcomes--the service delivery system--should, by law, be a spokesman, a mouthpiece, a standard bearer, an advocate for its consumer/clients. The agencies for the blind, to be very specific about it, have the legal and moral responsibility to speak out and pursue the programs, services, and activities required to reduce, and ultimately eliminate, the dependence of their clientele on others and especially their dependence on the agencies themselves, and to increase overall dependence as an interacting, communicating, and interpersonally competent human being on the spheres of economics, education, health, and politics in the greater society. The legitimate question, then, is what are the means and methods, both traditional and developmental, for accomplishing this kind of objective? What are the dimensions of the establishment in

utilization of such facilities in the service delivery system? I believe it is a basic assumption that such means should be cognizant of the dichotomous relationship that is inherent in the human resource service delivery system. More importantly, these methods have to be interpersonal in nature rather than a traditional person-to-person, communicator/communicatee kind of relationship. This concept implies that, for example, not only are the counselor and client equal in terms of the basic human qualities prevalent in both, but, further, the counselor has to take on a low profile with respect to his "position" in the system. In essence, the paternalistic style is not warranted and has proved to be a counter-productive method in the effort to involve the consumer in the consumer/provider process.

Advocate Technologies

Historically, social agencies, now referred to as human service institutions, have employed, as the basis of their service delivery vehicles, communication and transportation methods of the greater society as techniques for case finding, client contacts, client assessment, management reporting and accountability, financial administration and the like. As a result of agencies' sticking to this traditional mode of communication and transportation--the postal system, automobiles for counselors, the telephone--the degree of agency responsiveness by way of genuine consumer involvement has been very seriously limited. Human service workers have had to spend an untold amount of time traveling by car to their clients. Management support has had to be clumsy in its timeliness, having to depend primarily on the postal system. They, too, have had to assign themselves to massive paperwork. The information-gathering, retrieval, and dissemination process has suffered so much that it creates a chilling and negative effect on the intended outcomes of human service delivery.

The implementation of necessary incommensurate functions in the human service agencies has also served to only victimize intended recipients of this needed service by utilizing outdated and outmoded manual procedures, processes and systems.

The policy-making and legislative end of human services is, to say the least, irresponsible. Inputs of information for decision-making for policy development purposes are void of consumer content and victim to the absence of the means to facilitate consumer input.

The major concept with which we are concerned at this juncture is that of applying technological know-how to the service delivery system in its role as advocate and champion of the cause and plight of its consumers. Of immense criticality is the rapidly growing necessity to return to the role of the advocate and the facilitation of the human touch, which, by the way, on the surface appears to be a conflict in terms. But if this conviction is exposed to closer examination, it is readily apparent that technology developed in a vacuum is nothing more

than gadgetry. What we are talking about here at this conference is human factors-based technology. Technological development should ultimately facilitate and provide for a high degree of complementarity to human tasks. It does not and cannot replace the human being; it is not a substitute; it merely supports and complements the endeavor of a human being to achieve a desired task. To state it simply, man controls machines; the reverse is an indication that man is simply moving into the future with his back turned. This approach will only serve to confirm the contentions of George Orwell in his book titled 1984. It will have descended upon us by our own choice.

Advocate technologies in today's market are extremely costly and very complex. The systems are not new; they are quite traditional. The challenge facing all of us in business and industry, education, and government is to simplify these technologies which are essentially telecommunications in nature so that technologies, though an intimate part of a greater system, become more individualized to facilitate personal input and idiosyncrasies with respect to needs of consumers throughout the defined geographical area.

The most prominent technologies that are best suited to the admission of human service agencies fall within the broad category of telecommunications. For our purposes, telecommunications is defined as a technologically-based means and method of transmitting and receiving messages or information through channels, air, space, or wire with a desired effect, result, or impact upon the incoder/decoder or communicatee.

The plural nature of telecommunication systems permits flexibility and individuality on the part of users. It is multi-media in nature, accommodating information, receiving senses of sight, hearing, touch, or a combination of these with additional variations. The service delivery advocate has at his disposal such means as: (1) audio systems, both open- and closed-circuit; (2) television, both open- and closed-circuit, as well as low vision devices which function in self-contained units attached to traditional TV systems; (3) two-way cable systems which permit one-to-one or group-to-group communication; (4) tactile systems including braille and optaconics; (5) computer-based large print systems; and (6) audible communication networks and systems.

These technology-based telecommunication methods present wide open options to the imaginative manager or worker in the human services agencies. These approaches as well as other technological devices can, and I have no doubt will, constitute the platform and podium from which service delivery organizations can more responsively champion the needs and causes of their clientele and consumership. Relevance and immediacy are crucial values in any effort to make and utilize technology so that people are at the center of its utilitarian values as a "consumer manager communication system." In fact, employing these technologies will, in the long run, save staff/client time, travel and transportation services for staff and clients, and,

most importantly, it has the capability and capacity to bring the consumer on the scene and into the picture instantaneously, no doubt contributing to the increased quality of self-actualization by the consumer and obviously better job performance by management and service delivery workers.

Cheaper horse and buggy operations, in terms of dollars and cents, do nothing except create barriers between the service delivery level and the consumer/client stage of human service. We know, too, that the starter cost for telecommunication hardware is extremely high today. However, we also have witnessed that where there is increased demand, there is also price reduction. Although many agencies for the blind are small when compared to general vocational rehabilitation agencies, that's not a valid reason for maintaining a "horse and buggy" operation. The role of advocate is a big one, especially since it includes both agency and consumer. Advocate technologies are designed to facilitate wholesome service delivery.

Consumer Access to Technology

The overriding consideration of this discussion is the concern for the overall impact and effects of technology and technology-based telecommunications on the individual who is blind or visually impaired. Not only does the consideration concern itself with the practical applications of technological aids and devices in the adjustment training and job development and re-engineering process, but also the overall effects of this modern electro-mechanical know-how on the total human being in the process of achieving fulfillment and self-actualization in education, economics, government, business and industry, and even religion. One of the first barriers to effective utilization of technology and telecommunications is, and has been, the benign neglect of the idiosyncratic profiles of individuals with handicapping conditions whom technology is allegedly to benefit. This neglect, good or bad, results and culminates in the very same missed benefits. In essence, the gadgetry under the guise of technology creates additional barriers and, consequently, further handicaps the individual in both appearance and performance.

I think we all agree that, based on the experiences of human service workers and professionals, generally speaking most handicapped individuals are also poor, uneducated, and in many instances suffering from some physical or health ailment. That modern-day gadgetry, if you will, creates a kind of pseudo or pretentious feeling of having surmounted the handicaps to self-reliance through self-sufficiency and self-support only to discover in reality that they have compounded their problem and have been made to appear abnormal, or, to say the least, strangely different from other people.

It is extremely important for individuals who are blind or visually impaired or generally physically disabled to be intimately involved in all aspects of the process toward their

own rehabilitation and self-actualization. I believe it is necessary to include the client in the assessment, diagnosis, and determination of who he really is and what composes his frame of reference in terms of his value system, his interests, needs, beliefs, attitudes, and "goal" in life.

Consumer/client involvement in legislative affairs of the U. S. Congress has resulted in current pieces of important legislation mandating that the consumer/client be involved in the educational, rehabilitation and social services processes. The Rehabilitation Act of 1973 stipulates that an individualized rehabilitation program be written and continuously developed for each client in the rehabilitation process. This individualized program, for the first time, takes under consideration the views, goals, objectives, and resources needed to make the person an independent being of society. Further, Public Law 94-142, the Education for All Handicapped Children Act, provides for an assurance of the maintenance of individualized programs for all handicapped children.

The Rehabilitation Act of 1973 specifically includes the provision of telecommunications and sensory and other technological aids and devices as a basis for expanding and improving services to the handicapped. This mandate, however great the intentions, has the potential for the licensing of wholesale manufacturing of pure junk and useless gadgetry which transforms people into robots and a mass of vires, metal, transistors, and the like.

Technology and telecommunication devices should be designed and tailored to fit the uniqueness and the collective individuality of the various disability categories in direct response to the demands of daily functioning, whether at work or at play. To achieve this collective individualization, it is necessary that technologists research their aids and devices and develop them based on field research and testing with real handicapped human beings in real life work and recreational settings. Human factoring in product development and design is a prerequisite to consumer/client success in utilization and operational application of technologies.

Human factoring of technology to facilitate genuine and useful access by the blind means also that handicapped people must be actively participating in the development and design process. Their participation can insure at least a sensitivity to the concern that aids and devices, in order to maximize their utility, must be capable of going where the consumer/client goes without creating an unnecessary and unsightly scene which will, no doubt, create a mobility barrier for the individual. The portability issue must be addressed directly in the construction and design of technological devices. It is important to the individual that his aids remain inconspicuous in the delivery as well as the utility stages--they must remain unheard, unseen, and miniaturized. The appearance of the client is as important to him or her and the public as perhaps the utilitarian value of the

device itself. Appearance includes mobility of the person, the physical design of the device, and the portability of the machine.

The cost feasibility problem must be dealt with forthwith. Technology development will do very few of us any good at the rate we have moved in reference to the pricing of machines. Again, most clients are poor, and some form of income maintenance to survive in modern America is required. We just simply cannot afford to pay the price for what is being produced today. It is true that, theoretically, supply and demand govern what you and I pay for goods and services. We are a very small minority with perhaps less than a million severely handicapped blind in the nation who are potential users of some of the technologies. While it is desirable that the private sector produce these products, the cost problem demands that we urge, as consumers and clients, that alternatives be considered for developing and designing technologies. One of the solutions to the cost-access problem is for clients and consumers to lobby agencies, both federal and state as well as the Congress, to provide subsidies and tax credits and exemptions to head off the immense pricing of technologies designed to help the handicapped.

Information dissemination regarding developments and on-the-market aids and devices for the blind and visually impaired is lacking. A clearinghouse of sorts is essential if consumers are to access the technology realm of our society. Ultimately, the role of the consumer in accessing this technology process is that of understanding himself in relation to the demands of this culture. Getting a clear fix on one's having to function under the demands of a sighted world will go a long way in defining the composition and complexion of technology by those who will design it to meet the specific requirements of those who will use it.

APPLYING TODAY'S TECHNOLOGY AND
PLANNING FOR THE FUTURE

James C. Bliss

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Today's Climate for Technological Aids for the Blind

Modern technological aids specifically designed for the blind have been widely available only a relatively short time. However, their importance in the educational, vocational, and living skills development of the blind has rapidly increased to the point that laws have been modified, major funding established, and large programs instituted to disseminate these aids. The application of advanced technology to the needs of handicapped people is of increasing importance, not only to the handicapped end user, but to people in the field of rehabilitation as well.

While scientific and field evaluations of technological aids can give an indication of their value, the real test, which ultimately determines whether they continue to be available, is whether these aids are actually purchased. In this field, the end user and the funding source are often separate entities, so it becomes the responsibility of the funding source to represent the end user by expressing his needs and desires in purchase decisions. This means that either as direct end users, or as buyers of technological aids, it is up to you, the professionals who affect the lives of more disabled individuals than any other system set up to serve this population, to support worthwhile products and reject the unsatisfactory ones. This becomes especially difficult and complicated when a high technology aid is proposed and has not been subject to independent field evaluations, or when experience in the field does not exist.

Effective consumerism in the field of technological aids requires the same active involvement as consumerism in other fields. You must know and define your needs; you must make thorough comparisons of products and prices; and you must be able to make intelligent purchasing decisions. This process, which results in either consumer acceptance or rejection, functions in other sectors of the economy as a self-regulatory mechanism serving to encourage product improvement. In essence, it is a feedback system requisite to the continued vitality of an industry.

The vitality of the "technological aids industry" has thus far been maintained by a relatively small and diffuse group of concerned consumers. The self-regulatory mechanism of consumer acceptance, as evidenced through purchase decisions, has not been as strong a factor in the aids industry as it should be. The increasing proliferation of ideas for new devices and aids has

not been balanced by the stabilizing effect of consumerism--the Darwin theory of natural selection is not working--and survival of the fittest is not benefitting the end users.

As a result, work undertaken in the field of new devices and aids is, unfortunately, not always based on an understanding of the real problems and needs of the blind. Some device ideas are translated into experimental models, a few become production prototypes, fewer reach the stage of full-scale manufacture, and still fewer remain in production for more than a few years.

Yet the grapevine in the field and the media never seems to tire of spreading the word about a miraculous new "proposed" device that will, at last, be the panacea for the reading problem, the mobility problem, or some other need of the blind. This usually results in considerable excitement, which all too often turns into disillusionment as the cost/performance specifications become fully understood, or it is revealed that nothing will be available until after the successful completion of a long period of basic research. This disillusionment is usually derived from inappropriate expectations based on misconceptions resulting from communications between inventor and potential consumers.

In this climate, it must be very confusing for the workers in the blindness field to ascertain fact from fiction; that is, to determine which potential products have real promise, and which are passing fancy.

What is needed is a set of criteria to help put technological ideas into proper perspective. The attendees of this conference are becoming, either directly or indirectly, major consumers of technological ideas and products. To help in this regard, I've listed here some criteria with which to evaluate a proposed new idea.

Match between technical objectives and the needs of the blind. If all technical objectives are achieved, does the concept provide the solution to a real need? Have objective studies been carried out with sufficiently large populations of blind people to ascertain the benefits and the conditions in which these benefits are obtained? What are the disadvantages of the proposed device?

Technical feasibility. Is it reasonable to expect that the technological goals can be achieved? Are the goals within the state-of-the-art or is a breakthrough required? Is it clear what has already been achieved in contrast to what developments are still needed? What is the time schedule for completion?

Cost feasibility. Is the potential value or worth of the device greater than the projected materials and labor costs?

Credibility of product proponents. Who are the product proponents? Do they demonstrate a genuine concern and

understanding of the needs of the blind? What is their past involvement with the blindness system? Do they have a successful track record in the field of technological aids for the blind?

Organizational credibility. Is an organization evident that can manufacture, deliver on schedule, market effectively, and provide quality assurance, service, and training? Does the organization have a successful track record with other related products? Is the organization responsive to consumer feedback? Does it have adequate financial resources?

Organizational stability. If equipment were purchased today, is there reason to believe that service, spare parts, and other support will be available next month, next year, and ten years from now? Does the organization have a long-range commitment to the product, or is it only looking for a short-term financial or public relations gain?

An idea or a patent is a long way from a working model, a working model is a long way from a production prototype, and a production prototype is a long way from an established product. It is up to you, as consumers, to single out and support the worthwhile projects. Too often in this field, this important selection process lacks intelligent discrimination. Agencies, particularly at the end of a fiscal year, indiscriminately buy "one of everything." There is all too little planning of how to most effectively evaluate and apply the technology and establish worthwhile, long-range programs that will reach blind individuals. Indiscriminate buying, coupled with a lack of follow-through with widespread dissemination of worthwhile technological aids, serves to maintain a climate in which any "half-baked" idea may get much further than it should, while good products may have difficulty in receiving the consumer acceptance needed to get as far as they should. Poor inventors and organizations can be encouraged while good ones can be left without the necessary continued support.

Consumer advocacy in the field of technological aids for the blind is coming of age now, and it needs to be organized, visible, responsible, and bold. The continued vitality and productivity of the aids industry depends on it, and the studies which will be made in the alleviation of disabilities through the application of technology are now, and will continue to be, dependent on responsible consumer support by people like you.

Some Currently Available Technological Aids and the Need for Consumer Involvement

Particularly pertinent to this conference are some examples of technological aids currently available. Let me provide you with some examples of products whose need for consumer attention ranges from evaluation among different populations, to creative program development, to thorough dissemination programs. Telesensory Systems, Inc., is a company of over 100 employees committed to the use of technology for the

alleviation of physical handicaps, primarily blindness. TSI's staff is highly qualified, including over 15 with engineering degrees (three with Ph.D.'s), six with graduate degrees in business administration, six with degrees in education or business, and two with master's degrees in orientation and mobility.

The three major sensory aids for the blind produced by Telesensory Systems, Inc., are described below. Each description gives a profile of the product's present market status, feedback from consumers, and my impression of unmet needs which, if supported by consumer concern, could greatly extend the application and overall usefulness of these aids.

The Optacon Reading System

The Optacon, together with its accessories and training aids, comprises a complete system which can fulfill many of the reading needs of blind persons today. This system represents a mature family of products, backed by extensive training, service, marketing and engineering organizations. The Optacon has been in full-scale production for over five years. There have been many independent evaluations of the Optacon, and Table 1 gives a list of reports on the findings and conclusions. These are best summarized by the following recommendation from the American Foundation for the Blind:

All rehabilitation facilities and school systems should routinely include Optacon training in their programs for blind adults and children, and communities should set up central coordinating organizations to underwrite the costs and oversee the distribution of the device in their communities.

There are over 2,500 Optacons in the field today. The TSI Training Department has trained over 300 blind people and 200 teachers, and helped to initiate ten university programs in teacher preparation. This year more blind people will be trained to read with the Optacon in the United States than will be trained to use guide dogs. The three largest funding sources for Optacons are private foundations and service organizations, the international market, and state departments of rehabilitation. Figure 1 shows an Optacon Training Station.

A characteristic of the State Department of Rehabilitation segment is that a wide variety of policies are being applied across the 50 states. Some have excellent Optacon dissemination programs, while others have yet to purchase their first Optacon. This is in spite of the fact that all states have equal access, on a per capita basis, to the same federal funds, so variations in state budgets cannot account for the differences. It appears that the explanation for this state-to-state policy variation lies in the personal influence of individual leaders in the various rehabilitation departments.

Table 1

Independent Evaluations of the Optacon

<u>Authors</u>	<u>Title and Publisher of Report</u>	<u>Date</u>
Tobin, M. J. James, W. R. McVeigh, A. Irving, R.	PRINT READING BY THE BLIND, AN EVALUATION OF THE OPTACON AND AN INVESTIGATION OF SOME LEARNER VARIABLES AND TEACHING METHODS. Research Center for the Education of the Visually Handicapped, School of Education, University of Birmingham, England.	1973
Marmolin, H. Nilsson, L. G.	THE OPTACON AID, AN EVALUATION, Report No. 43. Department of Educational Research, School of Education, Uppsala, Sweden.	1973
Bertora, P. Biorci, G. Gambardella, G. Tagbasco, V.	NUOVA METODO DI LETTURA TATTILE. Le Scienze, Edizione Italiana di <u>Scientific American</u> , Numero 66, Febbraro 1974, duno Vil, Volume XII, pp. 34-41.	1974
Goldish, L. H. Taylor, H. E.	THE OPTACON: A VALUABLE DEVICE FOR BLIND PERSONS. <u>New Outlook for the Blind</u> , pp. 49-56.	1974
Weisgerber, R. A.	EDUCATIONAL EVALUATION OF THE OPTACON AS A READING AID TO BLIND ELEMENTARY AND SECONDARY STUDENTS. Final Report under Contract No. OEC-0-72-5780, Bureau of Education for the Handicapped, U. S. Office of Education. American Institutes for Research Report No. 34500-9/74-FR, Palo Alto, California.	1974
Schoof, L.	AN ANALYSIS OF OPTACON USAGE. American Foundation for the Blind Research Bulletin No. 29, pp. 33-50.	1975
Kaplan, I.	REPORT ON THE RICHARD KING MELLON FOUNDATION OPTACON TRAINING AND PURCHASE SUBSIDY PROGRAM (Pittsburgh City Area). American Foundation for the Blind, New York, 90 pp.	1975
Homma, K.	"TASTELESSEN DES JAPANISCHEN MIT OPTACON." Tokyo Metropolitan Rehabilitation Center for the Physically and Mentally Handicapped.	1975
Moore, M. W.	1974-75 REPORT OF THE PENNSYLVANIA OPTACON PROJECT FOR TEACHING READING TO VISUALLY HANDICAPPED STUDENTS. Sponsored by the Pennsylvania Department of Education.	1975



Figure 1. AN OPTACON TRAINING STATION

A major change in the distribution of sizes of market segments began to take place in 1976 when the U. S. Office of Education funded the first year of a planned three-year program to disseminate Optacons to schools throughout the United States. This program has resulted in over 30 Optacons being already delivered to universities and schools in Region IV, with a potential for over 150 more. Over the next few years, this program should greatly increase the educational application of the Optacon system. Next June there will be Optacon-trained blind students graduating from high school and entering the job market or college programs, and the number of these students will increase every year. I hope we have programs to provide them Optacons in place by that time; otherwise, the skills they will have learned in school will be of no use in the real world. In Region IV the most significantly successful program which is putting Optacons in the hands of working clients is in South Carolina. Smaller programs exist in North Carolina, Georgia, and Kentucky, but all of these programs will have to be expanded to be ready for the trained Optacon users who will be coming out of the educational system.

It has always been our policy to maintain a strong program which seeks to increase continually the reliability of the Optacon system. We have been unwilling to accept any level of service as "satisfactory"; instead, we have always sought for improvement and kept very detailed service records to assist us in making design changes. As a result, we have instituted over 250 engineering design changes in the Optacon over the past five years. These changes have cut the average frequency of repair of an Optacon to one-fourth of what it was in 1971. Our service agreement policy allows for incorporation of many of these changes in all Optacons so covered. We believe these systems have produced a very reliable product.

In the past five years we have come a long way toward the development of programs which can provide technological aids to handicapped people. Fifty years ago it was unheard of for the government to give anything to an individual; five years ago it was unheard of to give an individual anything but a welfare check. Today I have described several programs in which we have progressed to the point that equipment, purchased by government from a private company, is being provided to blind individuals. These programs are an excellent start; however, gaps remain in which justifiable needs are not being met.

I feel the major unmet needs today in the application of Optacon technology are in vocational education, with the college student, the deaf-blind, and in follow-up training. While the school systems are rapidly getting geared up to teach blind students to read with the Optacon, this training usually cuts off after some basic level of reading performance has been achieved. Yet the Optacon system offers much more, especially in the area of vocational applications, through its enhancement of typing, capability to read electronic displays of CRT's and LED's, and ability to read and handle forms. I believe good career

education curriculum using tools such as the Optacon and other technological aids needs to be developed and taught in all school systems.

In terms of dissemination programs, the blind college student too often has been left out. He frequently is ineligible for an expensive technological aid from rehabilitation departments because he is not yet seeking employment, and most of the educational programs cut off at the end of the 12th grade. Yet the college student is usually an ideal Optacon candidate, and the college years are much better suited for learning and perfecting Optacon reading skills than later. We need a strong program to provide technological aids, such as the Optacon, to appropriate college students so that they can realize their optimum educational and vocational potential.

Another unmet need is that of Optacons for certain deaf and blind individuals. Here the need and the value of the added communication made possible by the Optacon are clearly evident. I know of four exceptionally bright deaf-blind individuals who had to purchase their own Optacons in two cases and whose employers purchased them in the other two cases. The fact that we have no government program which can provide Optacons in these cases of clear need and utility is especially appalling to me.

As a final Optacon-related unmet need, I would like to mention follow-up or brush-up training. The nine-day training course presently used for Optacon reading is a compromise among cost, performance, and student saturation factors. Many students could benefit from additional training later, to help them go beyond certain plateaus in learning, to correct bad habits, to build speed, or to handle certain specialized materials. The programs need to realize and plan for this kind of additional training in order to obtain the full benefit from the investment already made in the Optacon.

The SPEECH PLUS Talking Calculator

In March of this year, Telesensory Systems, Inc., introduced a hand-held calculator designed especially for the blind. This calculator was developed after extensive surveys and evaluations with blind people.¹ In the six months since production commenced, there has been a very large response from the blindness community with over 2,000 calculators in the field today.

The major differences between funding sources for the SPEECH PLUS and those for the Optacon are that individuals comprise the largest segment, and private funding sources have not provided any significant programs. The four largest segments are: individuals, international, state departments of rehabilitation, and the Veterans Administration. The Veterans Administration program is the first large-scale dissemination program with the SPEECH PLUS, and it was initiated after the SPEECH PLUS was evaluated and approved by the Veterans

Administration Research Center for Prosthetics and by blind veterans themselves.²

Until recently, blind people were without an effective calculating tool. The abacus has been the traditional calculator for the blind, but with the trends toward mainstreaming and calculators in the classroom, both the ability to teach use of the abacus and the competitive effectiveness of the abacus have declined. The SPEECH PLUS talking calculator very effectively makes the convenience and computational power of hand-held calculators available to the blind. Feedback from the field has indicated that the SPEECH PLUS calculator is a highly reliable and effective tool which has enhanced the computational capabilities of many employed blind people as well as the everyday living skills of many. Figure 2 shows a picture of the SPEECH PLUS talking calculator.

Educators have long noted³⁻⁴ that, on the average, blind children were retarded, compared to their sighted peers, in the area of mathematics. We believe the SPEECH PLUS calculator, together with appropriate curriculum materials, can do a great deal toward bringing blind children up to grade level in the mathematics area. One study⁵ has shown 20-30 percent gains in computation and concept test scores by students after only three months' trial. A committee of educators in the field has been formed to survey this need, and Figure 3 gives the results of some key questions from this survey.

The committee's recommendations were reported at the American Printing House meetings last week. However, obtaining inclusion under the APH Field Quota is a very long and slow process with an uncertain outcome. What is needed is a state that is bold enough to institute a major educational program for blind students using the talking calculator. If this program is of sufficient size to demonstrate the effectiveness of this approach to the teaching of mathematics, then strong pressure for programs in other areas will naturally develop. Hopefully, some state will pick up this challenge and institute a program to provide these talking calculators to the classroom so blind students can operate on a more equal basis with their sighted peers.

Another presently unmet need is a program for disseminating talking calculators to blind vending stand operators. We believe the SPEECH PLUS calculator can provide a significant aid for them and may revolutionize the way in which their accounting needs are handled.

Finally, the elderly blind represent a group that can receive considerable benefit from the SPEECH PLUS calculator, especially in terms of increased independence.



Figure 2. THE SPEECH PLUS TALKING CALCULATOR

- If talking calculators were readily available to you, would you use them in your instructional programs?

Yes 250 No 11 N/A 17

- Do you feel it desirable and appropriate to have talking calculators available through the APH Federal Quota Program?

Yes 249 No 14 N/A 15

- Which talking calculator would you select?

SPEECH PLUS 87

Master Specialties 9500 9

Figure 3. Responses from a Survey of State Consultants and School Personnel Serving Visually Handicapped Children and Youth. Total number of respondents was 278.

The Sonicguide Electronic Mobility Aid

In 1975 TSI assumed the final assembly, distribution, and service responsibilities for the Sonicguide in North America. The Sonicguide is an ultrasonic mobility aid for the blind, originally conceived by Professor Leslie Kay, University of Canterbury, Christchurch, New Zealand. Through a five-year evaluation program funded by the Veterans Administration and The Seeing Eye, Inc., the currently available Sonicguide was developed. The final production model offers improved electronic technology and reliability over earlier prototype models. The Sonicguide is now manufactured by Wormald International Sensory Aids, Ltd. (WISAL) in New Zealand. The Sonicguide Electronic Mobility Aid is illustrated in Figure 4. In assuming full responsibility for the Sonicguide, an orientation and mobility instructor was added to our staff as manager of the mobility program, and a technology transfer program was instituted with WISAL.

The first obstacle to the availability of Sonicguides in the United States was the lack of qualified orientation and mobility specialists to teach effective use of the aid to blind individuals. Western Michigan University, through Veterans Administration funding, initiated a special training course in the fall of 1974 to meet this professional need. Subsequent university programs were developed at Boston College and through Bureau of Education of the Handicapped funding at San Francisco State University. Special courses have also been provided by Telesensory Systems, Inc.



Figure 4. THE SONICGUIDE ELECTRONIC MOBILITY AID

There are currently over 165 certified orientation and mobility specialists qualified to teach the Sonicguide in the United States and Canada and one in Brazil. These instructors represent 89 programs serving either visually handicapped adults or children. Fifty-one programs currently have Sonicguide training equipment to provide individual adult evaluation, assessments, and training. However, only 11 agencies have been able to initiate adult user aid funding because of the failure of administration to recognize the individual benefits of the device for independent mobility.

Figure 5 gives the preliminary results of a survey TSI conducted of 60 Sonicguide users. (There are now over 70 Sonicguide users in the United States and Canada.) We are very encouraged by the results and look forward to a greatly expanded Sonicguide program in 1977 and beyond.

- How has your use of the Sonicguide affected your independent travel ability?

32%	65%	3%		
increased	increased	stayed	lessened	lessened
considerably	somewhat	the same	somewhat	considerably

- How has the Sonicguide affected your environmental or spatial awareness?

52%	26%	19%		
increased	increased	stayed	lessened	lessened
considerably	somewhat	the same	somewhat	considerably

- Has the Sonicguide affected your personal self-confidence in mobility?

35%	55%	10%		
yes, greatly	somewhat	no	somewhat	greatly
improved	improved	change	lessened	lessened

Figure 5. Responses from a Survey of Sonicguide Users. Total number of respondents was 31.

The Sonicguide was originally developed as an adult mobility aid to be used in conjunction with a guide dog or long cane. Since the introduction of the device in the field, instructors have begun to look at expanded applications that are proving quite valuable to basic orientation and mobility instruction. These new applications include:

1. Training tool for basic adult O & M training. The Sonicguide is used as part of the regular training process to develop a conceptual framework and environmental awareness. For example, instructors are finding a substantially increased use of normal auditory information for individuals who have used the Sonicguide during their basic O & M instruction.
2. Training tool for spatial and concept development information with school-age visually handicapped children. The Sonicguide is used as part of the child's educational program to expand spatial and environmental information available during the individual instruction. The child uses the device only during the instructional period, and the Sonicguide becomes an available tool for the O & M instructor.

The San Francisco State University program was funded by HEW during the summer of 1976 to provide 12 O & M specialists from educational programs serving children with specialized training. There are presently 36 educational programs with qualified Sonicguide training instructors, 15 of these with equipment.

3. Training tool for low vision programs. The Sonicguide is used again to expand the low vision child's or adult's understanding of the environment to learn--for example, where to look and how to scan beyond visual range.

In regard to this application, a special project has been funded in New Hampshire to develop low vision applications during the next year.

4. Potential training tool with infants. A project at the University of Michigan has been funded by BEH to research the potential application of the Sonicguide with infant development and spatial awareness. This research project will involve the coordination of a medical team, O & M specialist, the Department of Special Education, and special equipment constructed at TSI. Although only preliminary in regard to what could be developed, this project will perhaps lead to the development of equipment for very young blind children.

The current obstacle to the expansion of Sonicguide programs has been available funds for the purchase of individual user devices. Several agencies, primarily located in the Midwest, have been able to secure funds to provide devices to their adult program clients. However, most instructors are faced with qualified candidates with no means to provide equipment.

One example of a newly developed program is the State of Virginia Commission for the Blind. This agency has recently developed a program to train all O & M specialists employed by the Commission--approximately ten people--to be able to utilize the device as it might apply to their teaching situation or client needs, both educational and rehabilitational. They are additionally providing individual user aids for adult clients served by the Commission where the Sonicguide would benefit vocational objectives.

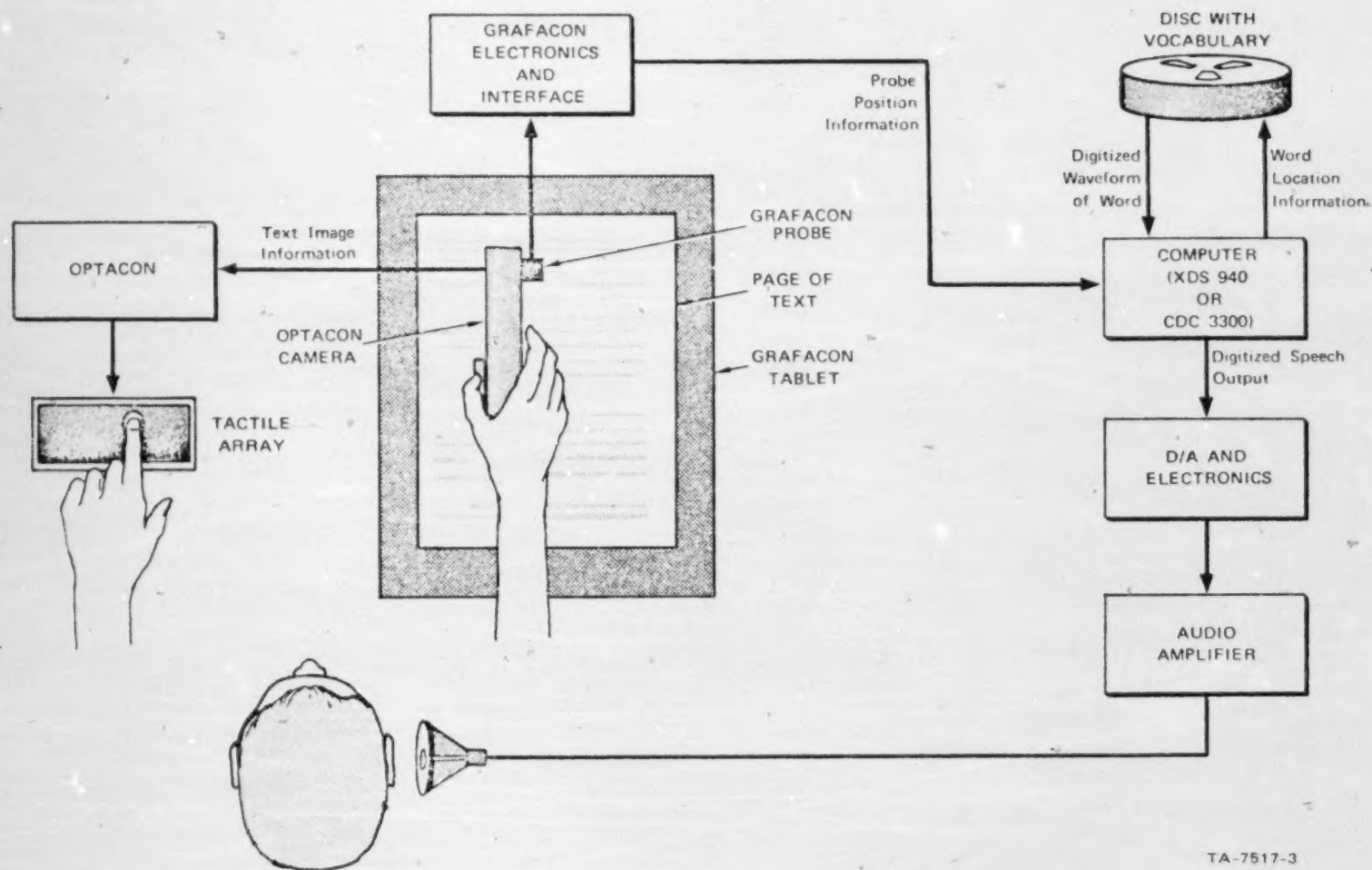
In regard to the southeastern region of the United States, there has been only limited interest in the Sonicguide. Instructors have been trained from Virginia, North Carolina, South Carolina, and Georgia. Aside from the Veterans Administration, only one user aid has been provided in South Carolina, although we have had a great deal of interest and contact with blind individuals from this region. Funds are therefore needed to (1) increase the number of Sonicguide instructors in both educational and rehabilitative programs, (2) provide instructors with training equipment, and (3) provide for the purchase of individual adult user aids.

Future Possibilities from Today's Research

Next, I would like to describe several research topics which are now receiving a great deal of attention at Telesensory Systems, Inc. It is our philosophy to maintain a strong research and development program and to search constantly for new product possibilities which fill real consumer needs, provide lasting value, match TSI's manufacturing and marketing strengths, and represent a contribution not already matched in the marketplace. We feel the following three projects can potentially result in products which meet these criteria.

A Spoken Word Output Accessory for the Optacon

As early as 1967, the Optacon engineering group was concerned with the feasibility of an accessory unit that would plug into the Optacon and speak the printed words as the user scanned them with the Optacon camera. This concern was prompted by the understanding that such an accessory would increase the reading speed possible with the Optacon, allow use by blind people having impaired tactile skills, and reduce the amount of training required for mastery of the reading system. By making the spoken word unit an accessory to the Optacon, none of the flexibility and portability of the Optacon is lost, system cost is minimized, and the performance range is maximized. In 1968 we conducted a study in which we simulated the system shown in Figure 6. This system enabled us to perform experiments in which a blind person moved an Optacon camera along a line of type, using the tactile array to keep the camera aligned to the type, and listened to spoken word output corresponding to the text being scanned.



TA-7517-3

Figure 6. SPOKEN WORD OUTPUT READING SYSTEM
SIMULATION IN 1968

These experiments indicated apparent technical feasibility for an accessory to the Optacon to provide spoken word output. This accessory would be plugged into the Optacon I/O connector and would perform the optical character recognition (OCR), orthographic-to-phonemic conversion, and speech synthesis functions.

In 1970 the cost of the hardware to perform this function was prohibitive; in 1976 the costs are still too high, but technological breakthroughs in the area of large-scale integration (LSI) of electronic microcircuits have substantially reduced costs and promise to continue to do so. Also, in 1970, techniques for automatic synthesis of speech from unrestricted text were not nearly as well developed as they appear to be today.

Last year TSI conducted a survey of a number of blind people who are Optacon users. Figure 7 shows some results from this survey. With this encouragement, arrangements were initiated within TSI to investigate whether a practical cost-effective system was on the horizon to provide spoken word output from an Optacon. In June of this year the National Science Foundation awarded us a grant to conduct this investigation. As a part of this study we have made an arrangement with the RLE Natural Language Processing Group at MIT to provide us with what we believe to be the most advanced system for unrestricted speech synthesis which is operational today.

<u>Item</u>	<u>Number</u>	<u>Percentage</u>
• Total Responses	61	
• Concepts	60	
Favorable	55	92
Unfavorable	5	8
• Ownership	30	
Personal	28	93
Institutional	2	7
• Tracking	36	
Hand	21	58
Automatic	15	42
• Other		
Cost	14	
Portability	7	

Figure 7. Responses to TSI Newsletter Survey

Our facility for this study consists of a PDP-11 computer to which an Optacon and a varied selection of special speech production circuits have been interfaced. Our plan is to use this facility to simulate, study, and refine the system until we see a way to transfer this technology into hardware that can be made available at a reasonable price and can deliver reasonable performance. We are very optimistic about being able to announce some exciting developments from this research area soon.

Paperless Braille

We have long been concerned with the archaic methods of writing used by the blind. Writing with a slate and stylus is noisy, slow, and complicated. A braillewriter is noisy, heavy, and relatively slow. Neither method has received any attention with respect to possible impacts due to the technological revolution over the past 25 years. This led us to begin to think about what kinds of writing methods would be appropriate for blind people in the 1970's and 1980's. How could modern technology be applied to improve read/write systems for the blind?

The concept we are exploring can be visualized if one thinks of a battery-operated unit a little larger than a portable cassette tape recorder. Along one side of this unit would be a

silent electronic keyboard with keys similar to those on many calculators, but laid out for braille. There would also be an electronically operated dynamic braille display of ten or more cells. The unit would also contain a cassette tape recorder (complete with microphone) together with a solid state memory and microcomputer circuits.

An example of how this system could be operated follows: A blind student could take the unit to class. He could silently take notes by writing braille into the solid state memory unit, and he could check and correct these notes by using the dynamic braille display. When the solid state memory was full (it might hold a few hundred words), he could transfer the contents of this memory to the cassette tape. He could also record voice using the unit as a normal tape recorder. If at a later time he wished to review his notes, he could simply put the cassette into the machine, play a block of text from the tape into the solid state memory, and read each line of this block of text using the dynamic braille display. (An efficient system of tape indexing can be provided.) At no time in this process is paper needed. Cassette tapes are used instead with a great reduction in bulk since one cassette could hold an entire book.

This line of thought leads to other possibilities as well. Services such as the Library of Congress and the American Printing House could send out cassettes which could be played in these "paperless" braille machines at a great reduction in reproduction, storage, and mailing cost over embossed paper braille. One machine serves as a tape recorder and as a braillewriter, with efficient editing, filing, indexing, and playback capabilities. (A braille printer could always be coupled to the device if it would ever be necessary to have a paper copy.) We feel this concept holds considerable promise as an efficient tool for blind people.

The Mowat Sensor

During the last four years the Veterans Administration and several adult rehabilitation agencies in the United States, Australia, and New Zealand have been evaluating another electronic travel aid (ETA) known as the Mowat Sensor. WISAL, in New Zealand, has recently undertaken redevelopment of this device, based upon evaluation findings, to make production units available by April, 1977. TSI will be offered the distribution rights, as with the Sonicguide, in North America.

The Mowat Sensor is a hand-held, battery-powered device about the size of a small transistor radio. The sensor emits high-frequency signals inaudible to the human ear which bounce back when obstructed by an object, wall or other area of resistance and are translated into vibrations within the device. The speed of the vibrations indicates the distance from the object. At the full extent of the sensor's range of 4.5 meters, the vibrations are slow, but they increase as the user approaches the object.

When the path ahead is clear, there is no vibration, but if there are several objects in front of the user and within the sensor's beam, the vibrations will indicate only the nearest object at any one time. The sensor has two ranges of beam depending on the required use. A person may use the sensor for extended periods while traveling or use it only for locating specific landmarks such as doorways, lamp or street sign posts, or other physical characteristics of the environment. The device is otherwise kept in a pocket or handbag ready for use as needed.

The device has applications both indoors and outdoors as a secondary mobility aid, as well as with low vision individuals and, because of the tactile feedback emitted, may be particularly useful with the deaf-blind. Cost of the device is about \$300.00.

The Movat Sensor is an example of how technology has become allied with the needs of the consumer and specialized field worker to develop and make available useful, dependable equipment.

Conclusions

The power source which makes the provision of useful aids for the blind an effective process is the financial commitment of the government and private agencies of and for the blind. This blindness system^e represented an annual commitment in 1966 of \$450 million, a rate obviously much lower than that in effect today. Unfortunately, most of this expenditure relates to provision of the necessities of life for the blind, or income maintenance. Too little has been committed to transformation of the blind from the position of welfare recipient to that of independent producer in our economic system. Good technology, intelligently applied, promises to help transform blind people into more productive members of society. In such a transformation all parties gain--the blind person, the government, private agencies, and society as a whole.

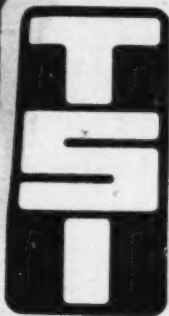
To date only a disappointingly small dent has been made in the problem of facilitating productivity of the blind through technological aids. As examples, I have described some of the unmet needs which could be helped today with the Optacon, SPEECH PLUS calculator, and Sonicguide. I have also described some promising research projects which we hope will enable us to do more in the future. There is much more to be done, much more should be done, and the consumers, professional workers in the field, and technologists will do much more.

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OPERATIONAL APPLICATIONS OF TECHNOLOGY

Telesensory Systems, Inc.



TELESENSORY SYSTEMS, INC.

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THE OPTACON HAS DRAMATIC IMPACT ON EVERYDAY LIVING FOR THE BLIND

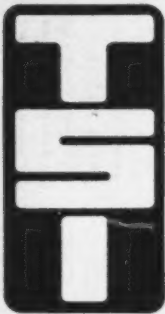
The Optacon is a compact, portable reading aid which gives blind and deaf-blind people independent and immediate access to the world of print. Using advanced electronics, the Optacon converts the image of a printed letter into a vibrating tactile form that a blind person can feel with one finger. Different type styles and languages can be read with the Optacon because it reproduces exactly what is printed. The usual step of tape or braille transcription is thus eliminated, providing Optacon users with a new degree of independence and privacy.

AT HOME. With the ability to read print directly, blind people can independently carry out a myriad of everyday tasks. Optacon users can read their own bank statements and bills. They can identify package labels, follow recipes in printed cookbooks, and read story books to children. Personal letters and correspondence can be read privately. The Optacon also expands the range of reading materials available to the blind by enabling them to enjoy books and magazines which are neither recorded nor brailled.

IN SCHOOL. The Optacon makes the instructional and resource materials of the sighted directly usable by the blind. Departments of education, local school boards, and private schools have initiated programs to make Optacon instruction available to blind students. Primary grade students use the Optacon in learning to read. High schools and community colleges have integrated Optacon instruction into their vocational education programs, and university students use it to pursue advanced studies in the sciences, foreign languages, law and other fields. The Optacon has been particularly important to blind students in advanced mathematics, as it enables them to read complex equations directly without relying on cumbersome braille transcriptions.

AT WORK. The Optacon has helped blind people to obtain jobs, to advance on the job, and to enter vocational areas previously closed to them. A number of accessories augment the Optacon's versatility and flexibility in adapting to different vocational needs. A blind computer programmer, in addition to being able to read a printout, can easily adapt the Optacon to directly read the luminous display of a cathode ray tube terminal. A typewriter attachment enables a blind secretary to read what is being typed, make typing corrections, and fill out preprinted forms. Another accessory enables a blind engineer or scientists to use the Optacon to read the visual display of an electronic calculator.

The Optacon helps to eliminate vocational barriers where independent access to print is important. Optacon users are identifying and creating dozens of new, non-stereotyped vocational opportunities. The Optacon is enabling many employed blind people to be promoted beyond entry level positions which often do not fully utilize their talents.



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Blind administrators, teachers, computer programmers, scientists, lawyers, social workers, secretaries and many others who use the Optacon feel that it has made their abilities and skills more competitive--they have more opportunities and greater freedom, independence, and privacy.

HOW THE OPTACON WORKS

The Optacon (OPTical-to-Tactile CONverter) works by converting regular inkprint into readable, vibrating tactile form. To read with the Optacon, the blind person moves a miniature camera across a line of print with one hand. The index finger of the other hand is placed on the Optacon's tactile array, which is approximately one inch long and one half inch wide. As the camera is moved across a letter, the image is simultaneously reproduced on the tactile array by miniature vibrating rods. The reading finger feels the enlarged letter as it passes across the tactile screen. The reader feels whatever image is viewed by the camera's lens. For example, as the camera is moved across an upper case "E," the reader feels a distinct vertical line and three horizontal lines moving beneath the finger.

OPTACON DESIGN. The Optacon is a portable, battery-powered unit. It weighs just four pounds and is about the size of a small cassette tape recorder (2"x6"x8"). It comes in a handsome leather case with adjustable shoulder strap for carrying. This compact unit consists of three integral parts: the camera module, the electronics section, and the tactile stimulator array.

HOW TO PURCHASE

The price of the Optacon Model R1C is \$2895 f.o.b. Palo Alto, California. Shipping and handling charges as well as state and local taxes will be added when applicable.

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AN INNOVATIVE EMPLOYMENT DEVELOPMENT PROGRAM
THROUGH THE UTILIZATION OF
ADVANCED TECHNOLOGY

Vito A. Proscia

Optacon Fund, Inc.
Palo Alto, California

The specific purposes of this paper are to describe the Innovation and Expansion Grant Project awarded to Optacon Fund, Inc., by the state of California and to review the impact of technology on employment development for the blind.

Optacon Fund is a non-profit, tax-exempt corporation registered in the state of California. Five members serve as the Board of Trustees and have a dedicated interest in offering and supporting innovative programs and services to the blind. Optacon Fund was initially established in June, 1973, by a founding grant from Seeing Eye, Inc. The purpose of the grant was to establish a "revolving fund" to provide financial assistance to qualified blind persons desiring to purchase Optacons. Over 40 loans have been sponsored under this grant program, and applications are still being submitted for consideration by individuals throughout the United States and Canada. To date, the revolving fund is still intact and the incidents of remittance are still perfect. It is probably well known that Seeing Eye has supported a number of sensory aid programs including dissemination and training of Optacon activities and Sonicguide evaluation and development programs.

Another major area of concern to the trustees of Optacon Fund is blind school children of all ages who have participated in Optacon training and evaluation programs and whose families do not have the means of purchasing these devices. A second award was received by Optacon Fund in 1975 from The Irvine Foundation to conduct a pilot study with economically and socially disadvantaged blind school children to determine the impact of the Optacon on the educational process and the personal life style of a selected group of youngsters. Fifteen children were screened and four were selected as candidates for the one-year program. Each child was trained and provided with an Optacon at no cost to the family. This program focused on the utility of the Optacon in the schoolroom and in the home environment. The project is considered to be successful, and a final report is available from Optacon Fund.

In addition to the above supported programs, Optacon Fund was fortunate enough to receive a grant under "Innovation and Expansion Federal Form Funds" administered by the state of California. The overall purpose of this project was to initiate an affirmative action program for the investigation and development of new employment opportunities for adult blind and deaf-blind through innovative technological advances, sensory

aids and in cooperation with the rehabilitation services of the state. The project has now been in operation for more than one year. The trustees were required to make a commitment to the project since cost-sharing was required for the first year and each succeeding year. The trustees felt that the project warranted the investment since the results of this effort could potentially have a national impact.

We all know that blind persons continually demonstrate the capacity of adapting to most situations in daily life enabling them to function independently with very little sighted assistance. However, one area which poses a serious problem for many blind persons is employment. Even in the enlightenment of the past decade, blind persons in our country have a significantly higher unemployment rate than their sighted peers. It is often expressed that among the employed blind there is a marked underemployment. Many of the difficulties incurred in locating suitable employment for the blind can be attributed to lack of information, public resistance to employment for the handicapped, misinterpretations, and casting blind people in traditional roles. I believe we have made considerable progress in the past year, and through the enforcement of affirmative action legislation employment development can be accelerated.

In the past decade there has been a significant increase in sensory aid technology paralleling the rapid advances of science and engineering. Sensory aids are instruments, devices, or mechanisms which provide the user with useful information. However, the extent to which modern sensory aids and rehabilitation engineering can be adapted to current needs of the existing employment market was never systematically investigated prior to the Optacon Fund project. We have demonstrated that a systematic and comprehensive employment development program which utilizes the expertise of the technologist and the skills of the rehabilitation placement specialist does culminate in expanded employment opportunities for the blind.

The overall goal of Optacon Fund's program is to initiate and establish an expanded employment development program nationwide through the utilization of existing sensory aids and rehabilitation engineering in cooperation with state rehabilitation services. The principle objectives of the first year were:

1. To identify five new entry-level jobs.
2. To catalog existing sensory aids relating to employment applications.
3. To arrange for the development of new sensory aids to meet employment needs.
4. To select and place 20 individuals in competitive employment positions.

5. To disseminate information on sensory aids and employment opportunities to people and organizations concerned with employment and rehabilitation of blind persons.

A summary of achievements with respect to objectives met in the first year of the grant are as follows:

New Entry-Level Positions (includes occupations and/or industry). The Optacon Fund staff has made 24 placements in the 1975-1976 grant year. Of these, 11 placements have occurred in eight new employment areas. Following is a chart describing the entry-level situations:

<u>Job Title</u>	<u>Company</u>	<u>Blindness</u>
Claims Examiner	Occidental Life Insurance Company	2 Low Vision
Word Processing Operator	Wells Fargo Bank Sears, Roebuck & Co. Fireman's Fund Ins.	2 Blind
Library Assist.	Cal. State Dominguez	1 Blind
Deputy Clerk/ Interpreter	Harbor Municipal Court	2 Low Vision
Insurance Sales.	Traveler's Insurance	1 Blind
Refrigeration Repairman (Machinist)	United Airlines	1 Blind
Physical Science Tech.	U. S. Geological Survey	1 Blind
Electronics Technician	Hewlett-Packard	1 Low Vision

All of the above employees are functioning satisfactorily according to the reports received from the employers.

Employment-Related Sensory Aid Catalog. A review of the first edition of the sensory aid catalog is nearing completion and contains more than 140 items. Cross-reference and subject categories are also being laid out. A comprehensive index system is being prepared in order that the subject matter can be easily accessed. Optacon Fund is presently seeking funds to publish the catalog for a wide distribution.

Development of New Sensory Aids for Employment Needs. An example of a new device developed for the program is the Electronic Pressure Gauge. United Airlines has recently rehired an employee who has been off the job for one and a half years due to his blindness. A variety of techniques and adaptations were

made in his placement--the most important of which is the Electronic Pressure Gauge. With this device, the blind employee is able to rebuild refrigerator compressors for airplanes and is eligible for journeyman machinist wages. When the machinist has completed repairs on the refrigeration system, shop procedures require him to check the system for gas leaks. Air is forced into the system until it reaches a pressure of 300 pounds per square inch. It is then necessary to monitor the pressure. Sighted machinists do so by watching a large gauge with a needle pointer. Since this needle is too delicate to be touched by the blind machinist, project staff were required to pursue other alternatives. The San Francisco Rehabilitation Engineering Center has devised an auditory gauge which accomplishes the same accuracy as the dial gauge and is being used very effectively by the blind machinist.

Similar engineering projects have been conducted in adapting devices and aids for a variety of job situations. In most cases, the devices made the job possible and improved the productivity of the employee. Examples of these are special dial indicators, jigs, and fixtures, templates and more sophisticated equipment such as closed-circuit TV (CCTV) components enabling low vision persons to effectively interact with a Selectric-style typewriter system.

Placements. Optacon Fund, in cooperation with rehabilitation counselors, has placed 24 individuals in competitive and viable jobs. Examples of job titles and employer and sensory aids required appear in the following chart:

<u>Job Title</u>	<u>Employer</u>	<u>Sensory Aid</u>
Claims Examiner (two placements)	Occidental Life	CCTV, large print calculator, large print manual, low vision aids
Engineer	Hughes Aircraft	Triformation LED 120, Optacon, Optacon calculator lens, scientific calculator
Word Processing Operator	Wells Fargo Bank, Int'l. Division	Optacon
Library Assist.	Cal. State Dominguez Hills College Library	Optacon, template, talking calculator, light probe
Machine Operator	Pattern & Prototype Works	Jigs and fixtures

<u>Job Title</u>	<u>Employer</u>	<u>Sensory Aid</u>
Secretary/ Receptionist	Build Rehabilitation Industries	Optacon, Optacon typewriter attach- ment, L.A.S.T. call director de- vice
Deputy Clerk	Harbor Municipal Court	Two camera CCTV head mounted telescopic aid
Deputy Clerk Interpreter	Harbor Municipal Court	Portable CCTV, low vision aids
Small Appliance Repairman	Los Angeles County, Maintenance Division	Adapted test board, Simpson me- ter (tactile read- ings), cassette recorder with foot control, computer terminal
Insurance Salesman	Traveler's Insurance	Keypact, talking calculator, vari- able speed cas- sette recorder with compressor
Dark Room Tech. (two placements)	Stanford University Medical Center, Department of Radiology	Adaptive tech- niques
Refrigeration Repairman (Machinist)	United Airlines	Electronic pres- sure gauge, click torque wrench, braille micro- meters, cassette recorder with foot control
Electronic Assembler	Pride Electronics	Diode tester, ad- aptive soldering techniques, epoxy applicator
Word Processing Operator	Sears, Roebuck & Company	Adaptive tech- niques
Physical Science Technician	U. S. Geological Survey	Lexicon, Optacon
Medical Transcriber	Kaiser Foundation Hospital	Optacon, L.A.S.T. call director device

<u>Job Title</u>	<u>Employer</u>	<u>Sensory Aid</u>
Electronics Technician	Hewlett-Packard	Low vision aids, telescopic loupe, CCTV, Weller desoldering equip.
Telephone Service Rep.	U. S. Social Security Adminis.	CCTV and microfiche reader attachment
Word Processing Operator	Fireman's Fund Insurance	Low vision aids

In summarizing, the staff of Optacon Fund was able to place 17 blind individuals and 7 low vision individuals in challenging job situations. The initial goal of 20 placements was exceeded as described by the proposed grant. It is felt that with the momentum gained and the knowledge gained in making these placements, the number of jobs can be increased significantly in the second year of operation.

Information Dissemination. Optacon Fund has fulfilled the objective of information dissemination to the rehabilitation community through the publication of three quarterly reports in the first year of the program. The quarterly reports include information on placements, new employment areas, expansion of traditional employment, engineering updates, feature articles on sensory aids, information on sensory aid catalog, and evaluation performance data. The quarterly reports have been widely distributed throughout the United States and abroad. Other forms of information dissemination occur through speaking engagements and attendance at conferences and seminars.

The staff of the Optacon Fund Innovation and Expansion Grant Project has made great progress in learning how to achieve placements for the blind and visually impaired through the use of sensory aid techniques, occupational evaluations in industry, and in cooperation with the state rehabilitation services. It is clear that through the introduction of technology, a greater impact has been created on a blind person's performance in a job situation. In a number of cases, it made the difference between acceptance and rejection for employment. The scope and availability of a variety of aids have broadened the numbers of opportunities for jobs.

The uniqueness of this project is the engineering funds and resources which are available and which can be applied to a solution of specific needs. In addition, funds are also available to purchase devices outright.

The principle objectives for the second year of the project are as follows:

1. Identify and achieve placements in five new entry-level employment areas for persons who are blind and/or multiply handicapped blind (severely disabled).
2. Select and place 35 individuals in competitive employment.
3. Upgrade or expand five entry-level positions held by blind or multiply handicapped blind persons.
4. Provide on-call assistance to employees whose loss of sight would result in unemployment.
5. Expand and update the existing Optacon Fund Sensory Aid Catalog.
6. Disseminate information on sensory aids and employment opportunities to rehabilitation counselors for the blind and other people concerned with employment and rehabilitation of blind persons.
7. Establish an employment development model for the use of rehabilitation counselors for the blind.
8. Complete case studies and detailed papers on placement techniques, sensory aids technology, and project management for inclusion in professional journals and industrial publications.

The project staff is made up of two vocational specialists (one sighted and one blind), a sensory aid specialist, a project manager, clerical support, consultants and an advisory committee. The vocational specialists are responsible for occupational evaluations, identification of new employment areas, placements and the selection of appropriate sensory aids for job application. The sensory aid specialist has been accumulating data of a technical nature and assembling and preparing material for the Sensory Aid Catalog. The project manager is responsible for the day-to-day operational functions of the entire project.

The advisory committee has been appointed from members of the community and the rehabilitation system. Representatives are selected from the state rehabilitation services, including counselors, supervisors, and administrators; representatives from industry, from personnel and technology; and representatives from the project, including Optacon Fund staff. The Board of Trustees of Optacon Fund has appointed a Board representative to direct the entire project.

In conclusion, it is important to state that we are presently facing a unique challenge, and with the support of government and private resources, the trustees of Optacon Fund believe that this challenge can be met. It has been demonstrated that over a brief period of one year, progress has been made in providing new opportunities of employment for the blind. It is

felt that by establishing this very important groundwork, a nationwide program should evolve.

OPERATIONAL APPLICATIONS OF TECHNOLOGY

Computer Braille Project
Atlanta Public Schools

COMPUTER BRAILLE PROJECT

Thomas J. McConnell, Jr.

Computer Center
Atlanta Public Schools

A system has been developed at the Computer Center, Atlanta Public Schools, to translate and produce hard-copy braille on an IBM System 370/158. The purpose of this project is to make braille materials accessible to visually impaired students so that they may compete successfully with their sighted classmates. This paper discusses the different phases involved in the translation system, including problems, personnel involved, necessary hardware, and operation of the software packages.

The Atlanta Public Schools have had a multi-faceted educational program for blind students for a good number of years. All such students receive regular classroom instruction along with their sighted classmates under the guidance of a regular classroom teacher. This instruction is augmented by the services of a "vision teacher" who visits schools on a rotating basis and works with the blind student and with his regular classroom teacher. Standard administrative procedures dictate that when possible, textbooks are obtained from the American Printing House for the Blind and from the school system's own Library for the Blind. In those frequent cases when needed books are not available, approximately 20 volunteers help transcribe materials working at their homes with braillewriters. Thus, the computerized system is used when braille materials are not available from other sources.

The original Computer Braille Project in the Atlanta Public Schools was partially funded under Title VI of the Elementary and Secondary Education Act (ESEA). Local administrative and financial commitment to the project has been substantial, and over the years local contributions have far exceeded those received from federal funding sources. The project was designed to develop a program to alleviate the problem of limited reading materials by providing braille materials for the visually impaired via the computer. The project has brought about an increased accessibility of educational material in braille for blind students who attend classes with their sighted schoolmates.

Under the present system, books and other materials are typed into the computer via ATS (Administrative Terminal System). Terminals are connected remotely to the computer system from the Vision Center. The materials thus entered into the system are proofread, corrected and then stored on Direct Access Storage

Devices (DASD). The data can also be stored on magnetic tape for archives purposes. Historical tape storage is a very cost-effective method of data storage, and these tapes can be used later as input to the braille translator. Each edition of a braille book is given to the student, so no library function is performed. Additional copies can be produced from the archives tape without any further translation. Once translated via Brlmaster, the material is embossed into braille by a high-speed printer equipped with a special print train. This hardware change is easily and quickly made to the standard IBM 1403N1 printer. Thus, dual hardware utilization makes this a very cost-effective alternative for braille production. The printer speed is approximately 600 braille lines per minute or 400 characters per second. The system runs on an IBM 370, Model 158 computer. The operating system is SVS 2, Release 1.7H.

The original braille translator, DOTSYS III, was developed by the Massachusetts Institute of Technology under contract from the Atlanta Board of Education. The present braille translation systems, Brlmaster and Brltable, are new systems that have been designed and developed within the Computer Center and the Vision Center, Atlanta Public Schools. The original system DOTSYS III was written in COBOL, and the newer systems Brlmaster and Brltable are written in PL/I. These programs contain extensive capabilities for text editing and formatting. Among these are tabulation controls, page and line formatting, poetry, and special braille symbols. The system is capable of producing two types of braille as well as an inkprint proof copy for a sighted braille editor. Punched card output can also be obtained and used for compatibility with other systems. The two types of braille are (1) a low-quality braille produced on standard computer paper for use by computer programmers and (2) a high-quality braille for the general reader produced on 90-pound paper utilizing an interchangeable print train which works very much on the same principle as a braillewriter.

An interface program accepts the output of ATS, which consists of DASD data sets or archives tapes, and converts it to a format compatible with the Brlmaster program. This program makes use of certain features of ATS commands, Brlmaster commands, teleprocessing characters, and rules of Standard English Braille.

Experience with the software indicates a high degree of performance, and no modifications have been required of the system for a number of years. Improved flexibility, accuracy of translation, and systems availability within the environment for which it was designed make the system very productive and efficient.

One of the chief goals for using an automated system such as has been described is the total elimination of the need to know braille by those persons within the school district who must prepare the input. This goal has been almost totally attained, and it is within reach in the foreseeable future. One of the

chief problems is the rather vigorous standards set forth by the rules of Standard English Braille, including the unique formatting of braille publications. Our solution to this problem is the utilization of an input editor whose job is to examine each publication to uncover any unique formatting situations and to look at the Brlmaster printout for any major deviation from the braille rules. Obviously, an input editor must have at least a partial knowledge of braille and braille book formats, and preferably a background in data processing, in order to determine the cause of the errors encountered. A Library of Congress-licensed braille proofreader is a vital part of the project, and all materials produced must have approval of this individual before items are released for general distribution.

The progress of the project has been substantial, but like any other, it has had its problems as well as its rewards. For example, some of the previously encountered problems were the correct formatting of braille title pages, tables of contents, indexes, tables and charts, and text materials, as well as errors in translation. Solution to these problems was found by merely becoming familiar with the ATS and Brlmaster editing commands and a little ingenuity in their application. The correction of errors in translation was not so easy. At the time of delivery the original DOTSYS III program was not 100 percent operational. Due to the absence of final documentation of the DOTSYS III program, much time was spent in trial and error with dictionary changes and program modifications. As translations were made, errors were found and corrected. Some of these involved modification of the dictionary and other modifications to the program itself.

Because of the specific requirements within a textbook environment, certain additions became apparent. Among these were an inkprint page number in braille and double line spacing in textbooks produced for the primary grades.

The project has presented many satisfying experiences. Among the first braille translations was the Ohio State University Psychological Test for a visually impaired student competing with sighted students for the Governor's Honors Program. This enabled the student to take the test without outside help. One instance where computer braille proved helpful was the translation of an ecology book which permitted a visually impaired student to enroll in a newly organized oceanography course. Another highlight of the project was meeting the daily demands of the first visually impaired student-programmer to enroll in the Atlanta Area Technical School.

With the assistance of MIT, IBM, Georgia Institute of Technology, Georgia State Department of Education, and many others, Atlanta Public Schools have made a significant contribution toward automating processes of braille production. A system has been designed not for one particular agency but for anyone who has the necessary equipment. It is believed that modern technology and know-how have brought together such

components and skills to make this the most thoroughly automated system of computer braille translation. Brlmaster and Brltable are operating in a number of other locations around the country. The system will operate on most IBM hardware and is available for a nominal fee. It can be a most powerful tool in the hands of its users and ushers in a new era in providing a better life for the visually impaired.

WHERE WE GO FROM HERE: RECOMMENDATIONS AND PROPOSED PROGRAMS

Stephen J. Cornett

Region IV Office of Rehabilitation Services
Atlanta, Georgia

I was a little bit overwhelmed, being a Kentuckian and reading all of the intelligentsia on this program, and especially the part that said I was to summarize the conference. That's quite a mouthful to chew, so I would like you to join me in looking over where we are and thinking about where we are going. I will not get into the details of technology. I have just come from a 50-cent tour given to me by Tim Cranmer of Kentucky on some of those devices, and it was really quite enlightening. Let me say that, first, our office is extremely interested, not only in the telecommunications, the technological services to the blind, but also in the whole blind program. I happen to serve as the National Convenor for the Blind for the Rehabilitation Services Administration, which means it is my job to mobilize all of the other regions in this country and work with the commissions and state vocational rehabilitation agencies in the regions in bringing more services to the blind. You can be sure that the rest of the country is going to hear about this conference. We in the federal government are very proud to be able to fund this conference, which is a first, not only in this region, but nationally. We wish to thank all of you, and Bill Waters, and the Raleigh Lions Club for bringing together and working up a short-term training application to get this conference going.

Let's begin by looking at some important points that are going to permeate what we do in the future. These points are the underpinning of the rehabilitation program that is ongoing. One, in the Rehabilitation Act of 1973, the basic theme brought out is the severely disabled. The Act says first priority will be given to the severely disabled. That, of course, is your major aim and mine. The Act also reaffirms that "v" in VR means "vocational," and we sometimes forget this. It says as a requirement of eligibility that all of the services will be in terms of employability. That does not mean that we don't have noble aims in helping every individual improve to the highest level of which he is capable, but don't forget that services in the Rehabilitation Act of 1973 are tied to employability. The Act also has an underpinning emphasizing the consumer, the client. It provides for the client to be an integral part of the rehabilitation process. He will develop with the counselor his individualized written rehabilitation program.

The 1973 Act introduced evaluation. We will evaluate what we do. Nine evaluation standards have been developed to assess the rehabilitation process. Being accountable for what we are doing, with quality services, is the new thrust. The use of similar benefits, in concert with other resources, is another

important part of the process. All of these things are the underpinning on which we are going to build for the future. So, when we ask now where we are going in telecommunications from here, let's keep those kinds of things in the back of our mind.

Where are we going in telecommunications? Well, No. 1 coming out of this conference is a recommendation that, strangely enough, is just like one resulting from a conference I had in Vail, Colorado, a week ago, with all of the federal blind workers in all ten regions. At that meeting the No. 1 recommendation was to establish nationally a clearinghouse and national R & T center for the blind. We do not have one. We have 12 of them throughout the country for the general program, but none for the blind. A research and training center for the blind could be established under Sec. 202(b)(1) of the Act. We will begin our work now to put it in the pipeline so that we can ultimately get it. You know the federal government works like that--if you want something in two years, start the ball rolling now.

We said that this center will not only engage in research on causes of blindness and help in development of the instruments themselves and working in training of people, but also serve as a clearinghouse for information and consumer reports about prosthetic, telecommunication, mechanical, and artificial aids to the blind and visually impaired. The center should strive to become a nationally recognized resource for dissemination and utilization of information about blindness.

No. 2 in our recommendations is to establish support for telecommunication systems in the management of services and the delivery of rehabilitation work; make it part of the process. Support telecommunications in the management of the work; help the counselor to use the systems to better inform and better serve his cases day by day, through informational management, utilizing two-way cable, just in the regular daily work.

The No. 3 recommendation is that in each agency you have a person designated to know about and to understand technological aids and telecommunication systems, so that there is a particular focal point in the agency for this technology. Tim Cranmer told me this morning that the devices and aids that are valuable are the ones that the counselor can use and the things he can understand--not highly sophisticated things that we are awed by, but the everyday kind of things, the things that we can use and keep on talking. That is important, and not to get frustrated, but to try again.

Recommendation No. 4 is to have an annual conference. Have a get-together formally like this, exchange ideas; and when you get together, bring together not just those in rehabilitation, but bring together the private and public sectors, every group and people who are interested in blindness. I was very interested in hearing what many different organizations and agencies were doing. You know, we have a tendency to talk among ourselves and to just share information

among ourselves without getting the fresh cup, or the exchange of ideas of the university and the private sector, in all of the groups working together; that's what we want.

No. 5 is the development of a part of the curriculum concerning components in technology of the blind in universities that are teaching rehabilitation counseling. This would assist the rehabilitation counselor in having more technical knowledge to carry out his responsibilities. It would also develop resources as part of the regular curriculum of the master's degree in counseling.

No. 6 is to develop program components to assess blind devices and relate them to the job placement process. This would help adapt aids to the job so that the aid will not be an end result in itself. Tim was showing us a stop-watch, and you all saw it and said, "Gee, how many blind people use a stop-watch?" That is not the point; the point is that he developed this stop-watch for a client who was dispatching trucks and all kinds of information and, as a dispatcher, had to know the time that they left and came back and keep fairly accurate records. This is a way he could do it and adapt to what he is doing.

No. 7 is to try to get some funding from the federal system. You know that the Act mentions telecommunications and technological services. We know they are just in the developing stage. It is interesting to see if we could get some money in this area. Maybe there could be individuals in college curricula who could specialize in various kinds of technological devices. Universities have great capacities in the field of technology, and maybe, just maybe, there could be a person specializing in this technology who could develop and carry this information out. We certainly could include it as part of the rehabilitation counseling program.

No. 8 is to establish interagency program functions and maintain a liaison with other agencies in continually identifying other resources for the development of placement devices in rehabilitation. We must work together in bringing together the resources of all of the agencies, as exemplified by this conference.

These eight things I have listed are kind of arbitrary, but they are impressions that have bubbled up from the discussions that have gone on in this conference. They are limited only by our imaginations. Most important of all is that when we leave this conference and go back, we work very hard in bringing together on an ongoing basis within our resources the information and the people who are working on a common goal of helping the blind. When we see what the person down the street is doing, we should join together and cooperate in technology in order to give better services for the blind. That's where it is--not in an apparatus that is very interesting, but the end result of an apparatus that has application to an individual in making a better life for himself. He can take this apparatus and

use it in doing his job; he contributes to our society; he ends up with an enriched life. That's what all of us are about.

TECHNOLOGY AND TELECOMMUNICATION:
IN THE FINAL ANALYSIS

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The recognition and identification of the essential building blocks for the development and implementation of a viable technology-based program of self-support and self-sufficiency for the handicapped in general and the blind in particular are immensely critical. The moral support, in terms of both interest and need, necessary for the initiation of meaningful "pro-action" is crucial to the success and effectiveness of technology in human services. Further, consideration of the human factors with regard to the technical development, design, application, and utilization of technology as a coalescent hard surface in the "work for the blind" process is paramount to the goal of independence in the demands of daily living.

Great strides have been made in the accomplishment of a statutory foundation upon which the provision of telecommunication and technological services can be legitimately integrated into the delivery system to rehabilitate the blind and visually impaired of our society. Specifically, the Rehabilitation Act of 1973 (Public Law 93-112), Title XX of the Social Security Act of 1975 (Public Law 93-647) and the Education for All Handicapped Children Act of 1976 (Public Law 94-142) all created the necessary climate and statutory framework for the introduction of science and technology into the human development process. The strongest and most comprehensive new legal basis of technology service was set forth in the Rehabilitation Act of 1973 specifically to provide "Telecommunication, Sensory, and other Technological Aides and Devices," Section 103(a) (11).

Historically, the beneficiaries of technological advances have been those in the industrial establishment, and, for the most part, the individuals using the technology are almost exclusively non-handicapped. The effort to apply science and technology to the rehabilitation of the physically handicapped was seemingly incidental to its overall application in the demands of daily living. The utilization value of technology as a viable link in the process to render a blind individual productive, self-actualizing, and self-supporting is an emerging concept. Even in its rather fragmented and sporadic application as a rehabilitation tool, its impact and demonstrated effects are astonishingly positive. This is true even in the absence of any on-going systematic and scientific study of the design, application, and effects of technology in the work for the blind service delivery system.

Technology for the sensorially handicapped is a relatively new phenomenon in agencies serving the blind. However, evidence of its appropriateness and desirability emerged in sincerity in the 1960's when research and development were undertaken for the Optacon, and the establishment of the communications center for the blind was initiated in 1969 by the Minnesota State Services for the Blind. Further, the emergence of a systematic approach to technology development and utilization in the rehabilitation of the blind was a prominent occurrence in human development. For the first time, this communication system was reflective of the diversification inherent in the idiosyncratic profiles of persons who are blind. Some individuals who are blind prefer to use braille; some persons require the use of audio systems; and still others desire low vision devices and materials. No one approach is sufficient to meet the varying needs of the blind.

A relevant and responsive technological program to serve the blind and visually impaired must, as a minimum, be multimedia in nature and scope. Essentially, an effective system should be inclusive of the following features: telecommunications--radio, television, teleprinters, cable systems and telephone; tactile--computer braille and Optaconics; low vision--large print, large screen projection and visual aids and devices; and audio and audible--sonar systems, talking technology and electrotone systems. In addition to the technical nature and scope of the technology-based rehabilitation service delivery system for the blind, any such program must have the capacity to be practicable in terms of application and acquisition in the various specialty areas required to meet the full growth and development needs of the blind. The maximum rehabilitation potential criterion, when applied to the rehabilitation of the blind, inherently means the adjustment to blindness through the acquisition of certain basic skills to compensate for the loss of vision. In essence, technology must become an integral part of the rehabilitation process from case findings to job placement.

The concept of technology, in its broadest sense, takes on a coalescent role in human service--the traditional "soft services." So then, sensory aids and devices may function as "stand along" services and in all probability will enhance soft services when utilized as a companion service.

Beyond the question and concern for a technically feasible technology in human service is the greater requirement that technology and telecommunications be human-factored. Product development and design, in the research phase, must consider the persons who will be using the aids and devices. The design of sensory aids and devices must take into account not only the physical needs of the individual who is blind, but also the social and psychological attributes of leading a normal life. Poor design which is not based on human factors engineering is nothing more than gadgetry. Product development must facilitate the mobility, social, and appearance needs of the individuals who use it. The official recognition and formal establishment of a

program of technology-based rehabilitation services rests on several important events. I believe it's been sufficiently demonstrated within the pages of this report that some of these prerequisite events have taken place.

First, the legislative mandate and framework have been established. Second, the technical know-how of technology development and utilization in human services already exists. Third, some generally scientific research, development, and utilization of technology in the work for the blind process have been accomplished particularly by firms such as Telesensory Systems, Inc., and the National Institute for Rehabilitation Engineering. And fourth, consumers have become aware of and involved in rhetorical and public action to bring into fruition the operational applications of technology in education and training, as well as counseling and guidance and job development and placement. We can see measurable and observable results and actions from these areas.

In order for a full-fledged program of research and demonstration, as well as the utilization of technology and telecommunications, to be recognized as a legitimate and institutional service provision in the rehabilitation process, we contend that the following essentials must be implemented:

1. The United States Congress, after having provided the statutory authority on which to offer technology and telecommunications in the overall scope of rehabilitation services, must also provide the necessary appropriations to fund fully the provisions in existing legislation which authorize the utilization of such services in human resources. The authorization of such legislative provisions without an equivalent increase of financial resources only serves to retard the effectiveness of such legislation. Because of the high cost of hard services as well as the increasing cost of traditional soft services, failure of the Congress to appropriate companion funding for the newly authorized hard services simply results in less money and resources to carry out the rehabilitation objectives. The fact of the matter is that the quality of outcomes and results in human service programs will no doubt deteriorate.

The mandate of the Congress to serve the most severely handicapped is one, in light of the factors referenced above, that must be seriously assessed as to whether it is a reasonable and realistic pursuit of the rehabilitation program. The concept is applauded and welcomed by most individuals who are workers in rehabilitation. All of these mandates are interconnected and interrelated; consequently, the success of one depends greatly upon the success of the other. It appears, without question, that to serve the most severely handicapped also means the application and utilization of new, different, and

more expensive hard services. The Congress must be responsive to the needs of the handicapped population, but equally as important, the Congress must also be financially responsible for program authorization as well as program delivery.

2. The second essential for implementation is the rethinking and redefinition of the budget/service delivery dichotomy of the rehabilitation program. Admittedly, the specifics of such a redefinition activity are not clear at this juncture. However, we believe that in light of all the developments surrounding the utilization of technology and telecommunications as well as the requirement to serve those individuals with severe handicaps, it is sufficient cause for agency administrators, managers, and service workers to undertake a reprioritization of allocated resources. The awareness of the potential affirmative impact of technology on the rehabilitation of the blind has begun to generate demands for hard services by consumers and clients. Agencies are already beginning to feel the impact of such demands. A closer examination of the economics of service delivery to the severely handicapped is warranted, and so is an assessment of the current program to determine its relevance to emerging hard service trends. It is clearly an appropriate strategy to redefine the form or structure to keep pace and be consistent with accepted and legitimate functions.
3. The third essential, then, is the institutionalization of technology and telecommunications as a legitimate and viable tool in rehabilitation. Responsibility for a sound program of technology rests on the shoulders of individuals who are technically trained as rehabilitation engineers or rehabilitation technologists. But, too, the individual who is a thinker, synthesizer, conceptualizer and formulator of program and service applications of technology is crucial, in fact, to the very survival of the concept of human services. This person is the advocate who must form the necessary coalition with the consumer to keep this need constantly before the decision-makers.
4. The final essential is the necessity to coordinate and disseminate information on the development, research, application, utilization, and advancement of technology and telecommunications in work for the blind including rehabilitation, education, social adjustment, economic development and the like. The management of information dissemination is perceived to be a critical function of a technology clearinghouse.

The first conference on technology and the handicapped has proved to be tremendously successful, as indicated by the participants' unanimous agreement on its usefulness. The enthusiasm was so great that the participants have recommended an annual national conference on technology and the handicapped. However, it is only fair and accurate to say that the enthusiasm of the conference participants has been matched by their sense of frustration. In the words of one individual: "The conference was very useful; however, being blind and knowing that this technology exists and one cannot afford to purchase it merely serves to frustrate us."